Glossary and Index

Aeolian: Pertaining to the environment of deposition of sediments by wind, such as the sand dunes in a desert. Because fine-grained sediments such as clays are removed easily from wind-blown deposits, aeolian sandstones are typically clean and well-sorted **(Page 18)**

AFE: See **Approval for Expenditure (Page 150)**

Alkanes: Saturated hydrocarbons that have single bonds only and form the basis of most crude oil and natural gas. Alkanes are described by the general formula C_nH_{n+2}. The lightest of the series is methane (CH_4) and the heaviest is asphaltene ($C_{80}H_{162}$). A common member is paraffin ($C_{10}H_{42}$) **(Page 228)**

Alkenes: Unsaturated hydrocarbons that have a double carbon bond and are characterised by the formula C_nH_2. The simplest alkene is ethylene and it is often created by the steam cracking of LPG, ethane and light naphtha **(Page 229)**

Alternative Energy/Alternative Fuel: Renewable sources of energy—solar, wind, or nuclear energy—that can supplement non-renewable fossil fuels such as coal, oil and natural gas. For transportation applications, the following can be included:

- Ethanol, and other alcohols as well as seed based diesel fuel
- Fuel mixtures containing 85% or more by volume of methanol, denatured ethanol and other alcohols with gasoline or other fuels (e.g. natural gas)
- LPG (propane)
- Hydrogen
- Coal-derived liquid fuels, and
- Electricity (including electricity from solar energy) **(Page 281)**

American Petroleum Institute (API): Accredited standards developing organisation that produces standards, recommended practices, specifications, codes and technical publications, reports and studies that cover each segment of the industry **(Page 57)**

American Society for Testing and Materials (ASTM): International standards organisation that publishes technical standards for a wide range of materials, products, systems and services **(Page 298)**

Anticlines: Arch-shaped folds in rocks in which rock layers are upwardly convex. The oldest rock layers form the core of the fold, and outward from the core progressively younger rocks occur. Anticlines form many excellent hydrocarbon traps **(Page 20)**

API: See **American Petroleum Institute (Page 57)**

API Gravity: API measure of the specific gravity of crude oil or condensate in degrees. It is an arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API and is calculated as follows: Degrees API = (141.5 / sp.gr.60°F) - 131.5 **(Page 63)**

Approval for Expenditure (AFE): Process by which an organisation submits a proposal for a project's budget to investors for their approval **(Page 174)**

Arctic Exploration and Production (EP): Term generally applied to a field or activity that is located within the Polar or Arctic Circle (e.g. Russia, Finland, Sweden, Denmark, Norway, Canada and Alaska [US]) and offshore areas such as the Sea of Okhotsk, Sakhalin Island, the Beaufort Sea and the Barents Sea **(Page 298)**

Arenes: Unsaturated hydrocarbons characterised by a cyclic arrangement of six carbon atoms, the simplest of which is benzene C_6H_6. Arene derivatives include pharmaceutical products, solvents and paints such as paracetamol (C_6H_4) and toluene C_6H_5-CH_3. Naphthalene ($C_{10}H_8$) is a coal tar derivative and should not be confused with naphtha which is an alkane. They are often termed aromatics **(Page 230)**

Aromatics: See **Arenes (Page 230)**

Asphalt $C_{80}H_{162}$: Extremely heavy oil, dark brown to black, obtained by petroleum processing. Bitumen forms the main component of asphalt which is used widely for road surfacing **(Page 55)**

Asphaltene: See **Asphalt (Page 59)**

Associated Gas: Natural gas that is produced simultaneously with crude oil from the same reservoir **(Page 64)**

Asthenosphere: The lower layer of the Earth's surface that is considered to behave as a fluid over geological time. This fluidity permits the movement of the tectonic plates in all directions creating earthquakes, volcanoes, mountains and oceanic trenches along plate boundaries **(Page 19)**

ASTM: See **American Society for Testing and Materials (Page 298)**

Atmospheric Conditions: See **Standard Conditions (Page 57)**

Atmospheric Crude Oil Distillation: The refining of crude oil to separate it into hydrocarbon fractions at atmospheric pressure by heating to temperatures of about 600° to 750°F (depending on the nature of the crude oil and desired products) and subsequent condensing of the fractions by cooling **(Page 299)**

Aviation Fuel/Aviation Gasoline: A mixture of relatively volatile hydrocarbons, with or without small quantities of additives, that is blended to form a fuel suitable for use in aviation reciprocating engines. Fuel specifications are provided in the ASTM Specification D 910 and Military Specification MIL-G-5572. See **Jet-Kero (Page 228)**

Aviation Gasoline Blending Components: Naphthas that will be used for blending or compounding into finished aviation gasoline (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene and xylene) **(Page 300)**

Barrel: A unit of measure for oil and petroleum products that is equivalent to 42 US gallons **(Page 15)**

Basins: Depressions in the crust of the earth, caused by plate tectonic activity and subsidence, in which sediments accumulate **(Page 16)**

Bathymetry: The science of mapping sea beds. It can show the connection of islands to land masses and the influence of ancient river systems in carrying sediment downstream to once marine areas or those that are marine areas today **(Page 17)**

bbl: Abbreviation for barrel(s) **(Page 88)**

bbl/d: Abbreviation for barrel(s) per day **(Page 94)**

bcf: Abbreviation for billion cubic feet **(Page 44)**

BCP: See **Blowout Contingency Plan (Page 193)**

Benzene (C_6H_6): Aromatic hydrocarbon present in small ratios in certain crude oils. It is made commercially from petroleum by the catalytic reforming of naphthenes in petroleum naphtha or from coal in the manufacture of coke. It is also used as a solvent in the manufacture of detergents, synthetic fibres, petrochemicals and as a component of high-octane gasoline **(Page 230)**

Bicentre Bit: Eccentric bit usually having an offset pad or wing used to under ream or enlarge a wellbore **(Page 300)**

Biodiesel: Liquid biofuel suitable as a diesel fuel substitute or diesel fuel additive. Biodiesel is derived from bio-esters typically extracted from plant seeds or animal fats **(Page 265)**

Biofuels: Liquid fuels and blending components produced from biomass (plant) feedstocks. They can be blended with standard gasoline or diesel using ethanol and

bio-esters respectively. The use of biofuels may lower carbon dioxide emissions and replace fossil fuels. Used primarily for transportation **(Page 274)**

Biogenic: Produced by biological processes of living organisms **(Page 22)**

Biomass: Organic non-fossil material of plant or animal origin including crop, wood and agricultural residues, animal or municipal waste and aquatic plants. Used as a renewable energy source **(Page 205)**

Biomass Gas: Medium Btu gas containing methane and carbon dioxide that results from the action of microorganisms on organic materials such as landfills **(Page 267)**

Biomass Waste: Organic non-fossil material of biological origin that is a by-product or a discarded product. 'Biomass waste' includes: municipal solid waste from biogenic sources; landfill gas; sludge waste; agricultural crop by-products; straw; and other biomass solids, liquids, and gases **(Page 267)**

Bit/Drill bit: A downhole tool used for cutting or crushing formations that is attached to the lower end of the drill string. Three types exist: PDC, rollercone or diamond impregnated **(Page 24)**

Bitumen: Naturally-occurring heavy and viscous oil comprising hydrocarbons heavier than pentane. It may contain sulphur compounds and that, in its natural occurring viscous state, is not recoverable at a commercial rate through a well **(Page 55)**

Blowout: Uncontrolled flow of gas, oil or other fluids from a well to the surface **(Page 188)**

Blowout Contingency Plan (BCP): Contingency plan whose primary purposes are to minimise danger to life, and protect the environment and valuable assets by minimising response times and incorrect actions taken under stress **(Page 193)**

Blowout Preventer (BOP): Equipment installed at the wellhead to control the flow and pressure of fluids within the annular space between the casing and drill pipe or tubing during drilling, completions and workover operations **(Page 188)**

Bm^3: Abbreviation for billion cubic metres **(Page 258)**

BOE: Abbreviation for barrels of oil equivalent (used internationally) **(Page 126)**

Bottled Gas: Fuel gas supplied to a building in liquid form such as LPG, propane, or butane. It is usually delivered by tank truck and stored near the building in a tank or cylinder until used

Bottomhole Assembly (BHA): The lower part of the drillstring connected to the bit **(Page 148)**

British Thermal Unit (Btu): The quantity of heat required to raise the temperature of one pound of liquid water by 1° F at the temperature at which water has its greatest density (approximately 39° F) **(Page 63)**

Btu: Abbreviation for British thermal unit(s) **(Page 63)**

Bubble Point: The state of a system characterised by the co-existence of a liquid phase with an infinitesimal quantity of gas phase in equilibrium **(Page 60)**

Bubble Point Pressure: The fluid pressure system at its bubble point **(Page 60)**

Butane (C_4H_{10}): A normally gaseous alkane (straight-chain) hydrocarbon extracted from hydrocarbon extracted from natural gas or refinery gas streams. It includes isobutane and normal butane and is designated in ASTM Specification D1835 and the GPA specifications for commercial butane **(Page 63)**

Butylene (C_4H_8): Olefinic hydrocarbon recovered from refinery processes

Buy-Back Oil: Crude oil acquired from a host government whereby a portion of the government's ownership interest in the crude oil produced in that country may or should be purchased by the producing firm

Bypassed Footage: The footage in that section of hole that is abandoned as the result of remedial sidetrack drilling operations

CH_4: Methane, a mixture of light gaseous hydrocarbons that belong to the alkanes and have the general formula C_2H_{2n+2}, where n is the number of hydrogen atoms per molecule. Examples include butane (C_4H_{10}) **(Page 58)**

Cap Rock: An impermeable layer that seals off oil and gas deposits, ensuring that the oil and gas remains in place until it is tapped by the drilling bit or subjected to other geological forces **(Page 23)**

Carbon Cycle: All carbon sinks and exchanges of carbon. Carbon is removed by various chemical, physical, geological and biological processes. See also **Carbon Sink**

Carbon Dioxide (CO_2): Colourless, odourless, non-poisonous gas that is a normal part of the earth's atmosphere. CO_2 is a product of fossil-fuel combustion as well as other processes. It is considered a GHG as it traps heat (infrared energy) radiated by the earth into the atmosphere contributing to the potential for global warming. The GWP of other GHGs is measured in relation to that of CO_2, which by international scientific convention is assigned a value of one (1). Also see **Global Warming Potential** and **Greenhouse Gases (Page 23)**

Carbon Sequestration: Removal and fixation of atmospheric CO2 in a carbon sink through biological or physical processes

Carbon Sink: Reservoir that absorbs or removes released carbon from another part of the carbon cycle. The four sinks, which are regions of the earth within which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually including freshwater systems), oceans, and sediments (including fossil fuels)

Casing: Metal pipe inserted into a wellbore and cemented in place to protect both subsurface formations (such as groundwater) and the wellbore. A surface casing is set first to protect groundwater. The production casing is the last one set. The production tubing (through which hydrocarbons flow to the surface) will be suspended inside the production casing **(Page 52)**

Casing-Head Gas: Natural gas produced along with crude oil from oil wells. It contains either dissolved or associated gas or both

Catalyst: Substance that speeds up a process such as zeolite in refining **(Page 79)**

Catalyst Coke: In many catalytic operations (e.g., catalytic cracking), carbon is deposited on the catalyst, thus deactivating the catalyst. The catalyst is reactivated by burning off the carbon, which is used as a fuel in the refining process. This carbon or coke is not recoverable in a concentrated form

Catalytic Converter: A device containing a catalyst for converting automobile exhaust into mostly harmless products

Catalytic Cracking: Refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules. Catalytic cracking is accomplished by the use of a catalytic agent and is an effective process for increasing the yield of gasoline from crude oil

Catalytic Hydrocracking: Refining process using hydrogen and catalysts with relatively low temperatures and high pressures for converting middle boiling or residual material to high octane gasoline, reformer charge stock, jet fuel, and/or high grade fuel oil

Catalytic Hydrotreating: Refining process for treating petroleum fractions from atmospheric or vacuum distillation units (e.g., naphthas, middle distillates, reformer feeds, residual fuel oil and heavy gas oil) and other petroleum (e.g., cat-cracked naphtha, coker naphtha, gas oil, etc.) in the presence of catalysts and substantial quantities of hydrogen. Hydrotreating includes: desulphurisation; removal of substances (e.g., nitrogen compounds) that deactivate catalysts; conversion of olefins to paraffins to reduce gum formation in gasoline; and, other processes to upgrade the quality of the fractions

Catalytic Reforming: Refining process using controlled heat and pressure with catalysts to rearrange certain hydrocarbon molecules, thereby converting paraffinic and naphthenic type hydrocarbons (e.g., low octane gasoline boiling range fractions) into petrochemical feedstocks and higher octane stocks suitable for blending into finished gasoline. Catalytic reforming is reported in two categories. They are:

• Low Pressure: Processing unit operating at less than 225 psig measured at the outlet separator

• High Pressure: A processing unit operating at either equal to or greater than 225 psig measured at the outlet separator

Central Cooling: Equipment to cool an entire building with a refrigeration unit to condition the air. Typically central chillers and ductwork are present

Central Heating: Equipment to heat and store water for space heating and other purposes, which provides hot water from a single location for distribution throughout

a building. Typically, radiators and pipework are present in residential usage in the UK

CFCs: See **Chlorofluorocarbons (Page 250)**

Chlorofluorocarbons (CFCs): Various compounds consisting of carbon, hydrogen, chlorine, and fluorine used as refrigerants. CFCs are recognised as harmful to the earth's atmosphere **(Page 250)**

Christmas Tree: An assembly of valves, pipes and fittings installed at the top of a gas or oil well to control pressure and direct the flow of well fluids **(Page 204)**

City Gate: The point at which natural gas from a supply pipeline enters the smaller diameter distribution **(Page 220)**

CNG: See **Compressed Natural Gas (Page 99)**

Coal Bed Methane: Methane generated during coal formation which is contained in the coal microstructure. Typical recovery entails pumping water out of the coal to allow the gas to escape. Methane is the principal component of natural gas. Coal bed methane can be added to natural gas pipelines without any special treatment

Coal Gasification: Process of converting coal into gas by crushing coal to a powder, which is heated in the presence of steam and oxygen to produce a gas. The gas is then refined to remove sulphur and other impurities and can be used as a fuel or processed further and concentrated into chemical or liquid fuel

Coal Liquefaction: Chemical process that converts coal into clean-burning liquid hydrocarbons, such as synthetic crude oil and methanol

Co-generation: Production of electrical energy and another form of useful energy (such as heat or steam) through the sequential use of energy

Co-generation System: System using a common energy source to produce both electricity and steam for other uses, resulting in increased fuel efficiency

Co-generator: Generating facility that produces electricity and another form of useful thermal energy (such as heat or steam) that is used for industrial, commercial, heating or cooling purposes

Coiled Tubing: Long, small-diameter pipe flexible enough to be stored on and deployed from a large, truck-mounted roll. Used to replace jointed pipe in certain types of drilling, completions and workover operations **(Page 223)**

Coke (Coal): Solid carbonaceous residue derived from low-ash, low-sulphur bituminous coal from which the volatile constituents are driven off by baking them in an oven at temperatures as high as 2,000°F so that the fixed carbon and residual ash are fused together. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. Coke from coal is grey, hard, porous and has a heating value of 24.8 million Btu per tonne **(Page 232)**

Coke (Petroleum): Residue high in carbon content and low in hydrogen that is the final product of thermal decomposition in the condensation process in cracking. This product is reported as marketable coke or catalyst coke. The conversion is five barrels (of 42 US gallons each) per short tonne. Coke from petroleum has a heating value of 6.024 million Btu per barrel **(Page 232)**

Coking: Thermal refining processes used to produce fuel gas, gasoline blend stocks, distillates, and petroleum coke from the heavier products of atmospheric and vacuum distillation. It includes:

• Delayed Coking. A process by which heavier crude oil fractions can be thermally decomposed under conditions of elevated temperatures and pressures to produce a mixture of lighter oils and petroleum coke

• Flexicoking. A thermal cracking process which converts heavy hydrocarbons such as crude oil, tar sands bitumen and distillation residues into light hydrocarbons

• Fluid Coking. A thermal cracking process utilising the fluidised-solids technique to remove carbon (coke) for continuous conversion of heavy, low-grade oils into lighter products **(Page 233)**

Combined Cycle: Electricity-generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or heat recovery steam generator for utilisation by a steam turbine in the production of electricity. This process increases the efficiency of the electric generating unit **(Page 256)**

Combined Cycle Unit: Electricity generating unit that consists of one or more combustion turbines and one or more boilers with a portion of the required energy input to the boiler(s) provided by the exhaust gas of the combustion turbine(s)

Combined Heat and Power (CHP) Plant: Plant designed to produce both heat and electricity from a single heat source

Co-mingle: The combination of oil and gas production from more than one reservoir zone **(Page 179)**

Completion (Oil/Gas Production): Refers to the installation of permanent equipment for the production of oil or gas. If a well is equipped to produce only oil or gas from one zone or reservoir, the definition of a 'well' (classified as an oil well or gas well) and the definition of a 'completion' are identical; however, if a well is equipped to produce oil and/or gas separately from more than one reservoir, a 'well' is not synonymous with a 'completion' **(Page 33)**

Compressed Natural Gas (CNG): Natural gas which is comprised primarily of methane, compressed to a pressure at or above 2,400 psi and stored in special high-pressure containers. It is used as a fuel for natural gas-powered vehicles. **(Page 99)**

Compressibility: Compressibility, c, of any substance is defined by $\mathbf{c = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T}$

where the rate of change of volume with pressure is measured at constant temperature. For a liquid, c is almost constant (independent of pressure) and then integration gives $V = Voexp[-c(P-Po)]$ where Vo is the volume of the liquid at the initial pressure Po. If c is very small, $exp[-c(P-Po)] \approx 1 - c(P - Po)$ so that $\Delta V = -cVo\Delta P$, where ΔV is the change in volume accompanying the pressure change ΔP. **(Page 67)**

Compressor: An engine used to increase the pressure of natural gas so that it will flow more easily through a pipeline **(Page 217)**

Compressor Station: Any combination of facilities that supply the energy to move gas in transmission or distribution lines or into storage by increasing the pressure **(Page 217)**

Concession: Operating right to explore for and develop petroleum fields in consideration for a share of production in kind **(Page 77)**

Condensate (Lease Condensate): NGLs recovered from associated and non-associated gas wells from lease separators or field facilities, reported in barrels of 42 US gallons at atmospheric pressure and 60 °F **(Page 279)**

Connate Water: Aqueous impurities caused by differing levels of salinity and mineral salts within water present within rock pores before the hydrocarbons migrated into the reservoir rock. The volume of water that remains after migration is known as 'connate water'. Large volumes of water are commonly produced in conjunction with oil and gas **(Page 60)**

Conversion Factor: Used to convert data between one unit of measurement and another (such as between short tonnes and Btus or between barrels and gallons)

Core, Coring: Conducted using a PDC cutting element that has a hollow centre. This allows the cutting element to obtain a core of the formation that is being drilled **(Page 17)**

Corporate Social Responsibility (CSR): A concept whereby organisations consider the interests of society by taking responsibility for the impact of their activities on customers, suppliers, employees, shareholders, communities and other stakeholders, as well as the environment **(Page 85)**

Cost of Capital: Rate of return oil or gas development must offer to obtain additional funds. The cost of capital varies with: the leverage ratio; the effective income tax rate; conditions in the bond and stock markets; growth rate of the utility; its dividend strategy; stability of net income; the amount of new capital required; and, other factors dealing with business and financial risks

Cost of Debt: Interest rate paid on new increments of debt capital multiplied by one minus the tax rate

Cost Reduction in the New Era (CRINE): A catalyst for change within the offshore industry that drives down costs largely through the development of simple functional specifications and harmonised working practices **(Page 89)**

Cretaceous: One of three Mesozoic time periods: the Triassic (199-251 million years ago), the Jurassic (145-199 million years ago), and the Cretaceous (65-145 million years ago) **(Page 31)**

Cricondentherm: Maximum temperature at which liquid and vapour phases can co-exist in equilibrium for a constant composition, multi-component system **(Page 68)**

CRINE: See **Cost Reduction in the New Era (Page 89)**

Critical Pressure and/or Temperature: Pressure and/or temperature in a hydrocarbon system at the critical state **(Page 69)**

Critical State: State of a system at which all properties of the co-existing vapour and liquid phases become identical

Crop Residue: Organic residue remaining after the harvesting and processing of a crop often used in biofuel production

Crude Oil: Mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface-separating facilities. Crude oil is refined to produce a wide array of petroleum products including: heating oil; gasoline, diesel and jet fuels; lubricants; asphalt; ethane, propane, and butane; and many other products used for their energy or chemical content

Depending upon the characteristics of the crude stream, it may include:

• Small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casing-head) gas in lease separators and are subsequently co-mingled with the crude stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream are also included

• Small amounts of non-hydrocarbons produced with the oil, such as sulphur and various metals

• Drip gases, and liquid hydrocarbons produced from tar sands, oil sands, gilsonite, and oil shale **(Page 9)**

Crude Oil Input: The total crude oil put into processing units at refineries

Crude Oil Losses: Represents the volume of crude oil reported by petroleum refineries as being lost in their operations. These losses are due to spills, contamination, fires, etc., as opposed to refining processing losses

Crude Oil Production: Volume of crude oil produced from oil reservoirs during a given period of time. The amount of such production for a given period is measured as volumes delivered from lease storage tanks to pipelines, trucks, or other media for transport to refineries or terminals with adjustments for net differences between opening and closing lease inventories

Crude Oil Qualities: Refers to two properties of crude oil, sulphur content and API gravity, which affect processing complexity and product characteristics

Crude Oil Stocks: Stocks of crude oil and lease condensate held at refineries, in pipelines, at pipeline terminals and on leases

Crystalline Refined Wax: Light coloured paraffin wax

CSR: See **Corporate Social Responsibility (Page 85)**

Cubic Foot (cf), Natural Gas: Amount of natural gas contained at a standard temperature and pressure (15°C [60°F] and 14.7 psi [1 bar]) in a cube whose edges are one foot long **(Page 62)**

Day Away From Work Case (DAFWC): Recorded to highlight safety and the importance of conducting proper risk assessments. Performance will be measured and key criteria assessed such as days per ten thousand feet and Non-Productive Time (NPT) per well or asset **(Page 186)**

Deltaic: An area of deposition or the deposit formed by a flowing sediment-laden current as it enters an open or standing body of water, such as a river spilling into a gulf. As a river enters a body of water, its velocity drops and its ability to carry sediment diminishes, leading to deposition. Also termed Delta **(Page 18)**

Density (ρ): Equal to mass per unit volume, so if M is the molecular weight of the gas, that is the weight of one mole, then $\rho = \frac{MP}{ZRT}$

In the petroleum industry it is often useful to express densities in terms of pressure gradients, either MPa/m or (psi/ft). The molecular weight of a gas of density ρg relative to air is 28.97 ρg **(Page 24)**

Derivatives: Naphtha, gasoil, LPG and ethane are used as the raw material in petrochemical processes. There are more than 4,000 different petrochemical products, but those which are considered as basic products include ethylene, propylene, butadiene, benzene, ammonia and methanol. The main groups of petrochemical end-products are cosmetics, perfumes, plastics, synthetic fibres, synthetic rubbers, detergents and chemical fertilisers **(Page 55)**

Desulphurization: Removal of sulphur from oil or gas

Development: Preparation of a specific oil or gas deposit for commercial production; may require construction of access to the deposit and facilities to drill and complete wells **(Page 17)**

Development Costs: These are incurred to obtain access to proved reserves and to provide facilities for well construction, treatment, gathering, and storing of oil and gas. More specifically, development costs, depreciation and applicable operating costs of support equipment and facilities, and other costs of development activities are costs incurred to:

• Gain access to and prepare well locations for drilling including surveying well locations for the purpose of determining specific development drilling sites; clearing grounds; draining; road building; and relocating public roads, gas lines, and power lines to the extent necessary in developing the proved reserves

• Well Construction, development and service wells including the costs of platforms and of well equipment such as casing, tubing, pumping equipment and the wellhead assembly

• Acquire, construct, and install production facilities such as lease flow lines, separators, treaters, heaters, manifolds, measuring devices, production storage tanks, natural gas cycling and processing plants, and utility waste disposal systems, and

• Provide improved recovery systems **(Page 98)**

Development Drilling: Determines more precisely the size and configuration of an oilfield so that it may be commercially developed **(Page 52)**

Development Well: Well drilled within a proved area of an oil or gas reservoir to a given vertical depth known to produce oil and gas. Also see **Well (Page 72)**

Dew Point: State of a system characterised by the co-existence of a vapour phase with an infinitesimal quantity of liquid phase in equilibrium **(Page 62)**

Dew Point Pressure: Fluid pressure in a system at its dew point

Diesel-Electric Plant: A generating station that uses diesel engines to drive its electric generators

Diesel Fuel: A fuel composed of distillates obtained in petroleum refining operations or blends of such distillates with residual oil used in motor vehicles. The boiling point and specific gravity are higher for diesel fuels than for gasoline **(Page 233)**

Diesel Fuel System: Diesel engines are internal combustion engines that burn diesel oil rather than gasoline. Injectors are used to spray droplets of diesel oil into the combustion chambers, at or near the top of the compression stroke. Ignition follows due to the very high temperature of the compressed intake air, or to the use of 'glow plugs' which retain heat from previous ignitions (spark plugs are not used). Diesel engines are generally more fuel-efficient than gasoline engines, but must be stronger and heavier because of high-compression ratios

Directional (Deviated) Well: A well purposely deviated from the vertical, using controlled angles and azimuths to reach an objective location other than that directly below the surface location. A directional well may be the original hole or a directional 'sidetrack' hole that deviates from the original bore at some point below the surface

Distillate Fuel Oil: Classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines such as those in trucks and automobiles, as well as off-highway engines such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation

• No. 1 Distillate: A light petroleum distillate that can be used as either a diesel fuel (see No. 1 Diesel Fuel) or a fuel oil. See No. 1 Fuel Oil

• No. 1 Diesel Fuel: A light distillate fuel oil that has distillation temperatures of 550°F at the 90% point and meets the specifications defined in ASTM Specification D 975. It is used in high-speed diesel engines, such as those in city buses and similar vehicles. See No. 1 Distillate

• No. 1 Fuel Oil: A light distillate fuel oil that has distillation temperatures of 400°F at the 10% recovery point and 550°F at the 90% point and meets the specifications defined in ASTM Specification D 396. It is used primarily as fuel for portable outdoor stoves and portable outdoor heaters. See No. 1 Distillate

• No. 2 Distillate: A petroleum distillate that can be used as either a diesel fuel or a fuel oil. See No. 2 Fuel oil below

• No. 2 Diesel Fuel: A fuel that has distillation temperatures of 500°F at the 10% recovery point and 640°F at the 90% recovery point and meets the specifications defined No. 2 Distillate in ASTM Specification D 975. It is used in high-speed diesel engines such as those in railroad locomotives, trucks, and automobiles.

• Low Sulphur No. 2 Diesel Fuel: No. 2 diesel fuel that has a sulphur level no higher than 0.05 percent by weight. It is used primarily in motor vehicle diesel engines for on-highway use

• High Sulphur No. 2 Diesel Fuel: No. 2 diesel fuel that has a sulphur level above 0.05 percent by weight

• No. 2 Fuel oil (Heating Oil): A distillate fuel oil that has distillation temperatures of 400°F at the 10% recovery point and 640°F at the 90% recovery point and meets the specifications defined in ASTM Specification D 396. It is used in atomising type burners for domestic heating or for moderate capacity commercial/industrial burner units. See No. 2 Distillate

• No. 2 Fuel Oil and No. 2 Diesel Sold to Consumers For all Other end Uses: Those consumers who purchase fuel oil or diesel fuel for their own use including: commercial/institutional buildings (including apartment buildings); manufacturing and nonmanufacturing establishments; farms (including farm houses); motor vehicles; commercial or private boats; military; governments; electric utilities; railroads; construction; logging; or any other non-residential end-use purpose

• No. 2 Fuel Oil Sold to Private Homes for Heating: Private household customers who purchase fuel oil for the specific purpose of heating their home, water heating, cooking, etc. It does not include farm houses, farming and apartment buildings

• No. 4 Fuel: A distillate fuel oil made by blending distillate fuel oil and residual fuel oil stocks. It conforms to ASTM Specification D 396 or Federal Specification VV-F-815C and is used extensively in industrial plants and in commercial burner installations that are not equipped with pre-heating facilities. It also includes No. 4 diesel fuel used for low- and medium-speed diesel engines and conforms to ASTM Specification D 975

• No. 4 Diesel Fuel and No. 4 Fuel Oil: See No. 4 Fuel

• No. 5 and no. 6 Fuel Oil Sold Directly to the Ultimate Consumer: Includes ships, mines, smelters, manufacturing plants, electric utilities, drilling and railroads

• No. 5 and no. 6 Fuel Oil Sold to Refiners or Other Dealers Who Will Resale the Product: Includes all volumes of No. 5 and No. 6 fuel oil purchased by a trade or business with the intent of reselling the product to the ultimate consumers

Distillation Unit (Atmospheric): Primary distillation unit that processes crude oil (including mixtures of other hydrocarbons) at approximately atmospheric conditions. It includes a pipe still for vaporising the crude oil and a fractionation tower for separating the vaporised hydrocarbon components in the crude oil into fractions with different boiling ranges. This is done by continuously vaporising and condensing the components to separate higher oiling point material. The selected boiling ranges are set by the processing scheme, the properties of the crude oil and the product specifications **(Page 233)**

Downhole: Term used to describe tools, equipment, and instruments used in the wellbore, or conditions or techniques applied to the wellbore **(Page 29)**

Downstream: Term used to describe the refining and marketing sectors of the oil and gas industry **(Page 18)**

Drawdown: The differential pressure that drives fluids from the reservoir into the wellbore. The drawdown is also referred to as the rate of production

Drill Cuttings: Pieces of rock created as a drill bits drill through underground formations **(Page 29)**

Drill the Well on Paper (DWOP): A specialised training event used to enrol and focus the drilling team often achieved through 'Training to Reduce Unscheduled Events' and 'Drill the Well on Paper' exercises. Refers to the process of analysing each step of the well construction process to generate ideas for improving performance and reducing cost **(Page 159)**

Drilling: Act of boring a hole to determine whether oil and gas are present in commercially recoverable quantities to produce minerals or to inject fluids. The different types of drilling include:

• Exploratory: Drilling to locate probable mineral deposits or to establish the nature of geological structures. Such wells may not be capable of production even if oil and gas are discovered

• Developmental: Drilling to delineate the boundaries of a known mineral deposit to enhance the productive capacity of the producing mineral property

• Directional: Drilling that is purposely made to deviate from the vertical **(Page 35)**

Drilling and Equipping of Wells: Completion of well by commissioning the Christmas tree

Drillship: A vessel designed to drill subsea wells. Its drilling tower is located midship, where an opening in the hull allows the drill string to pass through. The drillship positioning system, consisting of acoustic sensors, propellers and computers, cancels out the effects of the wind, waves and currents that tend to move the ship from its position **(Page 136)**

Dry Gas: Volume of gas remaining after all water and NGLs have been removed **(Page 63)**

Dry Hole: Exploratory or development well that does not find commercial quantities of hydrocarbons **(Page 155)**

Dry Natural Gas: Natural gas that remains after the liquefiable hydrocarbon portion has been removed from the gas stream (i.e., gas after lease, field, and/or plant separation) and any volumes of non-hydrocarbon gases have been removed where

they occur in sufficient quantity to render the gas unmarketable. Note: Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60 °F and 14.73 psi absolute. See **Natural Gas**

Dual Fuel Vehicle: Motor vehicle operated on an alternative fuel and on gasoline or diesel fuel. This term is meant to represent all such vehicles whether they operate on the alternative fuel and gasoline/diesel simultaneously (e.g., flexible-fuel vehicles) or those that can be switched to operate on gasoline/diesel or an alternative fuel (e.g., bio-fuel vehicles)

DWOP: See **Drill the Well on Paper (Page 159)**

E85: Fuel containing a mixture of 85% ethanol and 15% gasoline. See **Motor Gasoline (Finished)**

E95: Fuel containing a mixture of 95% ethanol and 5% gasoline

ECD: See **Equivalent Circulating Density (Page 167)**

EIA: See **Energy Information Administration (Page 84)**

Electric Generation Industry: Stationary and mobile generating units that are connected to the electric power grid and can generate electricity. The electric generation industry includes the 'electric power sector' (utility generators and independent power producers) and industrial and commercial power generators, (including combined-heat-and-power producers) but excludes units at single-family dwellings

Electric Hybrid Vehicle: Electric vehicle that either: operates solely on electricity, or that also has an internal combustion motor that generates additional electricity (series hybrid); or, contains an electric system and an internal combustion system and is capable of operating on either system (parallel hybrid)

Electric Motor Vehicle: Motor vehicle powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, photovoltaic arrays or other sources of electric current

Electric Power Grid: System of synchronised power providers and consumers connected by transmission and distribution lines and operated by one or more control centres **(Page 290)**

E & P: Exploration and Production, the 'upstream' sector of the oil and gas industry **(Page 39)**

Emissions: Man-made gases released to the atmosphere such as GHGs, i.e. the release of carbon dioxide during fuel combustion **(Page 249)**

Energy Consumption: Use of energy as a source of heat or power or as a raw material input to a manufacturing process **(Page 278)**

Energy Demand: Requirement for energy as an input to provide products and/or services **(Page 236)**

Energy Efficiency, Electricity: Programmes aimed at reducing energy usage without affecting the services provided. These programs reduce overall electricity consumption (reported in MWh) by using more advanced equipment to produce the same level of end-use services (e.g. lighting, heating, motor drive) with less electricity. Examples include high-efficiency appliances; efficient lighting programs; high-efficiency Heating, Ventilating and Air Conditioning (HVAC) systems or control modifications; efficient building design; advanced electric motor drives; and, heat recovery systems **(Page 254)**

Energy Information Administration: An independent agency within the US Department of Energy that develops surveys, collects energy data, and analyses and models energy issues. The agency must meet the requests of congress, other elements within the Department of Energy, Federal Energy Regulatory Commission, the Executive Branch, its own independent needs, and assist the general public, or other interest groups, without taking a policy position. See more information about EIA at http://www.eia.doe.gov/neic/aboutEIA/aboutus.htm **(Page 84)**

Energy Reserves: Estimated quantities of energy sources that are demonstrated to exist with reasonable certainty on the basis of geologic and engineering data (proved reserves) or that can reasonably be expected to exist on the basis of geologic evidence that supports projections from proved reserves (probable/indicated reserves). Knowledge of the location, quantity, and grade of probable/indicated reserves is generally incomplete or much less certain than it is for proved energy reserves. Note: This term is equivalent to 'demonstrated reserves' as defined in the resource/reserve classification contained in the US Geological Survey Circular 831,

1980. Demonstrated reserves include measured and indicated reserves, but exclude inferred reserves

Enhanced Oil Recovery (EOR): A variety of processes to increase the amount of oil removed from a reservoir, typically by injecting a liquid (e.g., water, surfactant) or gas (e.g., nitrogen, carbon dioxide) **(Page 70)**

Environmental Restoration: Described as 'cleanup', this function encompasses a wide range of activities such as stabilising contaminated soil; treating ground water; decommissioning process buildings, nuclear reactors, chemical separation plants, and many other facilities; and exhuming sludge and buried drums of waste

Environmental Restrictions: Land or offshore restrictions that constrain, postpone, or prohibit certain activities to protect environmental resources such as surface or groundwater quality, air quality or plants or animals and their habitats

EOR: See **Enhanced Oil Recovery (Page 70)**

Epiric Seas: Shallow seas. Also known as epicontinental seas

Equivalent Circulating Density (ECD): The effective density exerted by a circulating fluid against the formation that takes into account the pressure drop in the annulus above the point being considered **(Page 167)**

ERD: See **Extended Reach Drilling (Page 53)**

Ethane (C_2H_6): Normally gaseous alkane (straight-chain) hydrocarbon. It is a colourless paraffinic gas that boils at a temperature of -127.48°F and is extracted from natural gas and refinery gas streams **(Page 63)**

Ethanol (CH_3-CH_2OH): Clear, colourless, flammable oxygenated hydrocarbon. Ethanol is typically produced chemically from ethylene, or biologically from fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. It is used in countries, principally Brazil and the US, as a gasoline octane enhancer and oxygenate (blended up to 10% concentration). Ethanol can also be used in high concentrations (E85) in vehicles designed for its use. See **Fuel Ethanol** and **E85 (Page 215)**

Ethylene: An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. Ethylene is used as a petrochemical feedstock for numerous chemical applications and the production of consumer goods **(Page 229)**

Exchange, Petroleum: See **NYMEX (Page 239)**

Exploration Drilling: Drilling done in search of new petroleum reserves **(Page 138)**

Exploratory Well: Also known as a wildcat well. A hole that is drilled to: find and produce new oil or gas reserves; drill in an area previously considered unproductive; and, to extend the limit of a known oil or gas reservoir (or delineation) **(Page 136)**

Extended Reach Development (ERD) Wells: A well whose horizontal or lateral section exceeds 6280 feet (2000 m) in length. ERD wells offer the ability to reach complex targets or reserves that maybe in environmentally sensitive areas **(Page 53)**

Extreme E & P: Encompasses reserves that are tough-to-reach or tough-to-access locations such as the Arctic, deepwater or hard-to-reach marginal reservoirs and hard-to-produce viscous oils. Within this definition we are concerned with conventional oil and gas above 13° API; therefore, excluding oil shales and gas hydrates as tough-to-produce **(Page 273)**

Facies: The overall characteristics of a rock unit that reflect its origin and differentiate the unit from others around it **(Page 33)**

Fahrenheit (°F): A temperature scale on which the boiling point of water is at 212° above zero on the scale and the freezing point is at 32° above zero at standard atmospheric pressure **(Page 66)**

Farm Out (In) Arrangement: An arrangement, used primarily in the oil and gas industry, in which the owner or lessee of mineral rights (the first party) assigns a working interest to an operator (the second party), the consideration for which is specified exploration and/or development activities. The first party retains an overriding royalty or other type of economic interest in the mineral production. The arrangement from the viewpoint of the second party is termed a 'farm-in arrangement' **(Page 48)**

Faults: Breaks in brittle rock which indicates displacement **(Page 20)**

FCCC: See **Framework Convention on Climate Change**

Feedstocks: Raw material used in the pharmaceuticals, plastics or manufacturing industry **(Page 268)**

Field: An area consisting of a single reservoir or multiple reservoirs associated with the same individual geological structural feature or stratigraphic condition. The field name refers to the lease and surface area, although it may equally refer to the underground producing formations **(Page 25)**

First Purchase (of crude oil): An equity (not custody) transaction commonly associated with a transfer of ownership of crude oil associated with the physical removal of the crude oil from a property for the first time (also referred to as a lease sale). A first purchase normally occurs at the time and place of ownership transfer where the crude oil volume sold is measured and recorded on a run ticket or other similar physical evidence of purchase

Fixed Platforms: These were the first units to be used. Preference has been given to them in fields located in water depths to 200 m. Fixed platforms generally consist of modular steel structures installed at the operation site with piles driven into the seabed. Fixed platforms are designed to receive all drilling equipment, material storage, and staff accommodation, plus all well-production facilities **(Page 136)**

Flared Natural Gas: Gas disposed of by burning it in flares usually at the production sites or at gas processing plants

Flexible Fuel Vehicle: Vehicle that can operate on alternative fuels (such as biodiesel or ethanol which are 100% petroleum-based fuels) and any mixture of an alternative fuel (or fuels) and a petroleum-based fuel. Flexible fuel vehicles have a single fuel system to handle alternative and petroleum-based fuels. 'Flexible fuel vehicle' and 'dual fuel vehicle' are synonymous terms

Flexicoking: Thermal cracking process which converts heavy hydrocarbons such as crude oil, tar sands bitumen, and distillation residues into light hydrocarbons. Feedstocks can be any pumpable hydrocarbons including those containing high concentrations of sulphur and metals

Flow Assurance: Methods employed to ensure that production or pipeline blockages are minimised or avoided. Blockages may occur due to heavy crude, low temperatures or the presence of scale **(Page 190)**

Fluid Cracking: Refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules. Catalytic cracking is accomplished by the use of a catalytic agent and is an effective process for increasing the yield of gasoline from crude oil. Catalytic cracking processes fresh feeds and recycled feeds

Fluid Coking: Thermal cracking process utilising the fluidised-solids technique to remove carbon (coke) for continuous conversion of heavy, low-grade oils into lighter products **(Page 232)**

Footage Drilled: Total footage for wells includes: the deepest measured depth (length of continuous well bores) of all wells drilled from the surface; the total of all bypassed footage drilled in connection with reported wells; all new footage drilled for directional sidetrack wells; and, all footage drilled in multilaterals. It does not include footage in the mother bore that is reported as footage for the original well. In the case of re-entries or existing wells that are drilled deeper, the reported footage is that which was drilled below the total depth of the existing well **(Page 172)**

Foreign Access: Proved reserves of crude, condensate, and NGLs applicable to long-term supply agreements with foreign governments or authorities in which the company or one of its affiliates acts as producer

Formation Damage: Reduction in permeability in reservoir rock due to the infiltration of drilling or treating fluids into the area adjacent to the wellbore **(Page 150)**

Formation-Volume Factor: Volume occupied by one volume of stock tank oil and its associated gases at an elevated pressure and temperature state (reservoir). Formation volume factors are further specified as liquid phase (single phase, Bo, Bg and Bw) or gas plus liquid phase (two phase, Bt) formation volumes

Fossil Fuel: Energy source formed in the earth's crust from decayed organic material. The common fossil fuels are petroleum, coal and natural gas **(Page 249)**

Fossil-Fuel Electric Generation: Electric generation in which the prime mover is a turbine rotated by high-pressure steam produced in a boiler by heat from burning fossil fuels

Fossil Fuel Plant: Plant using coal, petroleum or gas as its source of energy

Fractional Distillation: Refineries distil hydrocarbons into fractions according to their volatility; the most commonly known is petroleum spirit or gasoline. Fuels obtained during the refining process are LPG, naphtha, kerosene, gas-oil and fuel oil. Non-fuel products such as lubricants and asphalt (used in paving roads) can also be obtained during refining **(Page 230)**

Fractionation: Process by which saturated hydrocarbons are removed from natural gas and separated into distinct products or 'fractions' such as propane, butane, and ethane

Fracturing: The application of hydraulic pressure to the reservoir formation to create fractures through which oil or gas may move to the wellbore **(Page 24)**

Framework Convention on Climate Change (FCCC): Agreement opened for signature at the 'Earth Summit' in Rio de Janeiro, Brazil on June 4, 1992, which has the goal of stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent significant man-made forced climate change **(Page 24)**

Fuel: Material substance that can be consumed to supply heat or power. Included are petroleum, coal, natural gas (the fossil fuels) and other consumable materials such as uranium, biomass, and hydrogen **(Page 63)**

Fuel Cell: Device capable of generating an electrical current by converting the chemical energy of a fuel (e.g., hydrogen) directly into electrical energy. Fuel cells differ from conventional electrical cells in that the active materials such as fuel and oxygen are not contained within the cell but are supplied from outside. It does not contain an intermediate heat cycle, as do most other electrical generation techniques **(Page 264)**

Fuel Cycle: The entire set of sequential processes or stages involved in the utilisation of fuel including extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle

Fuel Efficiency: Producing the maximum amount of energy per unit amount of fuel consumed

Fuel Ethanol (C_2H_5OH): An anhydrous alcohol (ethanol with less than 1% water) intended for gasoline blending

Fuel Injection: Fuel delivery system whereby gasoline is pumped to one or more fuel injectors under high-pressure. The fuel injectors are valves that, at the appropriate times, open to allow fuel to be sprayed or atomised into a throttle bore or into the intake manifold ports. The fuel injectors are usually solenoid operated valves under the control of the vehicle's on-board computer (thus the term 'electronic fuel injection'). The fuel efficiency of fuel injection systems is less temperature-dependent than carburettor systems. Diesel engines always use injectors

Fuel Oil: Liquid petroleum product less volatile than gasoline that is used as an energy source. Fuel oil includes distillate fuel oil (No. 1, No. 2, and No. 4) and residual fuel oil (No. 5 and No. 6) **(Page 96)**

Furnaces: Heat directly without using steam or hot water (similar to a residential furnace). Furnaces burn natural gas, fuel oil, propane/ butane (bottled gas) or electricity to warm the air. The warmed air is then distributed throughout the building through ducts. Many people use the words 'boilers' and 'furnaces' interchangeably, but they are not the same. We mean that warm air is produced directly by burning some fuel. Warm-air furnaces typically rely on air ducts to carry the warm air throughout the building. Warm-air furnaces are often built in combination with central air-conditioning systems so that they can use the same air ducts for heating or air-conditioning (depending on the season). Other terms for describing this type of equipment include: 'central system', 'split system' and 'forced air/forced air furnace'

Futures Market: Trade centre for quoting prices on contracts for the delivery of a specified quantity of a commodity at a specified time and place in the future. See **ICE** and **NYMEX**

Gallon: Volumetric measure equal to four quarts (231 cubic inches) used to measure fuel oil. One barrel equals 42 gallons **(Page 55)**

Gas: Non-solid, non-liquid combustible energy source that includes natural gas, coke-oven gas, blast-furnace gas, and refinery gas **(Page 17)**

Gas Cooled Fast Breeder Reactor (GCFB): A fast breeder reactor that is cooled by a gas (usually helium) under pressure

Gas Exporting Countries Forum (GECF): Forum established in Teheran, Iran in 2001 with a view to managing global gas reserves and providing a stable and transparent energy market. The GECF consists of 15 gas-producing countries: Algeria, Bolivia, Brunei, Egypt, Equatorial Guinea, Indonesia, Iran, Libya, Malaysia, Nigeria, Qatar, Russia, Trinidad and Tobago, the United Arab Emirates and Venezuela **(Page 112)**

Gas Gravity: Ratio or the molecular weight of the gas to the molecular weight of air, 28.97. Gas is often measured in terms of moles, where the number of moles in the body of gas is defined to be the weight of the gas divided by its molecular (formula) weight. An important parameter for natural gas is the Gas-formation volume factor, Bg, which is the volume that unit volume of gas at standard conditions occupies when subjected to reservoir conditions, $B_g = \frac{P_{sc}TZ}{PT_{sc}}$, reservoir condition/ standard conditions.

Sometimes the reciprocal of Bg is used Eg. Eg has the advantage of being a near linear function with P, which is useful for hand calculations but not so important with computer based methods **(Page 70)**

Gasification: Method for converting coal, petroleum, biomass, wastes or other carbon-containing materials into a gas that can be burned to generate power or that can be processed into chemicals and fuels **(Page 286)**

Gasohol: Blend of finished motor gasoline containing alcohol (generally ethanol but sometimes methanol) at a concentration between 5.7 and 10% by volume. Also see Oxygenates

Gas Oil: European and Asian designation for No. 2 heating oil and No. 2 diesel fuel **(Page 43)**

Gasoline: Complex mixture of hydrocarbons, with or without small quantities of additives, blended to form a fuel suitable for use in spark-ignition engines **(Page 77)**

Gasoline Blending Components: Naphthas which will be used for blending or compounding into finished aviation or motor gasoline (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, and xylene). Excludes oxygenates (alcohols, ethers), butane, and pentanes plus

Gasoline Grades: Classification of gasoline by octane rating. Each type of gasoline (conventional, oxygenated, and reformulated) is classified by three grades—Regular, Midgrade, and Premium

• Regular gasoline: Gasoline having an anti-knock index, i.e., octane rating, greater than or equal to 85 and less than 88. Note: Octane requirements may vary by altitude

• Midgrade gasoline: Gasoline having an anti-knock index, i.e., octane rating, greater than or equal to 88 and less than or equal to 90

• Premium gasoline: Gasoline having an anti- knock index, i.e., octane rating, greater than 90

Gasoline Motor (Leaded): Contains more than 0.05 grams of lead per gallon or more than 0.005 grams of phosphorus per gallon. The actual lead content of any given gallon may vary. Premium and regular grades are included, depending on the octane rating, as is leaded gasohol. Blendstock is excluded until blending has been completed and alcohol that is to be used in the blending of gasohol is also excluded

Gas Plant Operator: Any firm, including a gas plant owner, which operates a gas plant and keeps the gas plant records. A gas plant is a facility in which NGLs are separated from natural gas or in which NGLs are fractionated or otherwise separated into NGL products or both

Gas Processing Unit: Facility designed to recover NGLs from a stream of natural gas that may or may not have passed through lease separators and/or field separation facilities. Another function of natural gas processing plants is to control the quality of the processed natural gas stream. Cycling plants are considered natural gas processing plants

Gas To Liquids (GTL): Process that combines the carbon and hydrogen elements in natural gas molecules to make synthetic liquid petroleum products such as diesel fuel **(Page 63)**

Gas Turbine Plant: Plant in which the prime mover is a gas turbine, which typically consists of an axial-flow air compressor and one or more combustion chambers where liquid or gaseous fuel is burned and the hot gases are passed to the turbine and where the hot gases expand to drive the generator and are then used to run the compressor

Gas Well: Well completed for production of natural gas from one or more gas zones or reservoirs. Such wells contain no completions for the production of crude oil **(Page 60)**

Gate Station: Location where the pressure of natural gas being transferred from the transmission system to the distribution system is lowered for transport through small diameter, low-pressure pipelines

Gas Well Productivity: Derived annually by dividing gross natural gas withdrawals from gas wells by the number of producing gas wells on December 31 and then dividing the quotient by the number of days in the year

GCFB: See **Gas Cooled Fast Breeder Reactor**

GECF: See **Gas Exporting Countries Forum (Page 112)**

Geochemist: Individuals who characterise changes in the organic material contained in rocks caused by time, heat and pressure. They will identify possible petroleum source rocks, assessing the burial history and hydrocarbon-bearing potential of the sediments **(Page 31)**

Geological and Geophysical (G&G) Costs: Costs incurred in making geological and geophysical studies including, but not limited to, costs incurred for salaries, equipment, obtaining rights of access, and supplies for scouts, geologists, and geophysical crews

Geological Repository: A mined facility for disposal of radioactive waste that uses waste packages and the natural geology as barriers to provide waste isolation

Geologist: Scientist who specialises in the structure of earth and in the history of its physical, chemical, and biological changes **(Page 17)**

Geophone: A device which converts ground movement (displacement) into voltage, which may be recorded at a recording station. The deviation of this measured voltage from the base line is called the seismic response and is analysed for structure of the earth **(Page 155)**

Geophysics: The study of the earth by quantitative physical methods - principally by measuring the gravitational, magnetic, electrical, and seismic-velocity properties of the earth's surface and interior **(Page 28)**

Geophysicist: Specialist in the branch of geology that deals with the physics of earth and its atmosphere including oceanography, seismology, volcanology, and geomagnetism **(Page 178)**

Geopressured: A type of geothermal resource occurring in deep basins in which the fluid is under very high-pressure

Geoscience: Study of geology and oceanography **(Page 211)**

Geothermal Energy: Hot water or steam extracted from geothermal reservoirs in the earth's crust. Water or steam extracted from geothermal reservoirs can be used for geothermal heat pumps, water heating, or electricity generation

Geothermal Plant: A plant in which the prime mover is a steam turbine which is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rock

Geyser: A special type of thermal spring that periodically ejects water with great force

Ghawar Field: Largest oilfield known worldwide located in Saudi Arabia. It has a continuous reservoir rock that is approximately 178 miles long by 16 miles wide by 0.5 miles deep **(Page 26)**

Giga: One billion

Gigawatt (GW): One billion watts or one thousand megawatts

Gigawatt-Electric (GWe): One billion watts of electric capacity

Gigawatthour (GWh): One billion watt hours

GHG: See **Greenhouse Gases (Page 250)**

Global Warming: An increase in the near surface temperature of the earth. Global warming has occurred in the distant past as the result of natural influences, but the term is today most often used to refer to the warming some scientists predict will occur as a result of increased anthropogenic emissions of GHGs **(Page 247)**

GOR: Gas Oil Ratio **(Page 59)**

GOSP: Gas Oil Separator Plant **(Page 71)**

Gravity: A standard adopted by the API for measuring the density of a liquid. Gravity is expressed in degrees with lower numbers indicating heavier liquids and higher numbers indicating lighter liquids **(Page 25)**

Greenhouse Gases (GHGs): Gases in an atmosphere that absorb and emit radiation within the thermal infrared range **(Page 250)**

GTL: See **Gas-to-Liquids (Page 63)**

GW: See **Gigawatt**

GWe: See **Gigawatt-Electric**

GWh: See **Gigawatthours**

GWP: See **Global Warning Potential**

Heat Content: Amount of heat energy available to be released by the combustion or use of a specified physical unit of an energy form (e.g., a tonne of coal, a barrel of oil, a kilowatt hour of electricity, a cubic foot of natural gas, or a pound of steam). The amount of heat energy is commonly expressed in Btus **(Page 285)**

Hedging: Buying and selling of future contracts so as to protect energy traders from unexpected or adverse price fluctuations **(Page 239)**

Hedging Contracts: Contracts which establish future prices and quantities of electricity independent of the short-term market. Derivatives may be used for this purpose

Helium: Gaseous element present in the sun's atmosphere and in natural gas that is used as a substitute for flammable gases in balloons

Henry Hub: A pipeline hub on the Louisiana Gulf coast. It is the delivery point for the natural gas futures contract on the NYMEX **(Page 258)**

High-Efficiency Lighting: Lighting provided by High-Intensity Discharge (HID) lamps and/or fluorescent lamps

High Pressure High Temperature (HPHT): High pressure high temperature wells considered to have bottom hole temperatures in excess of 300°F (150°C), and pressures which require a mudweight of 16.0 ppg (1.92 SG) or more to maintain well control **(Page 181)**

Homologous Series: A group of hydrocarbon (or other) compounds such as alkanes and alkenes that share the same general molecular formula **(Page 228)**

Hydrocarbon: Organic chemical compound of hydrogen and carbon in the gaseous, liquid, or solid phase. The molecular structure of hydrocarbon compounds varies from the simplest (methane, a constituent of natural gas) to the very heavy and very complex **(Page 23)**

Hydrocracking: See **Catalytic Hydrocracking**

Hydroelectric Power: Generated by the use of moving water running through a turbine generator to produce electricity **(Page 261)**

Hydrogen: A clear, odourless, highly-flammable gaseous element. Hydrogen is the lightest atom in nature and occurs mainly in combination with oxygen to form water. It can also be found in petroleum and other hydrocarbon solutions, acids, bases, and alcohols. It can be used to generate sustainable, emission-free energy through fuel cells **(Page 55)**

Hydro Power: Energy created by moving water. **(Page 261)**

ICE: See **Intercontinental Exchange (Page 239)**

IDC: See **Intangible Drilling and Development Costs**

Ideal Gas (Perfect Gas): Gas conforming to the equation of state, PV = nRT, where P is absolute pressure, V volume, M molecular weight, n the number of moles (n = mass/M), T absolute temperature, and R the universal gas constant. An ideal gas has a compressibility factor of unity under all conditions. Real gases approximate to the ideal behavior at low pressures although never assume all of the properties of an ideal gas **(Page 62)**

IEA: See **International Energy Association (Page 277)**

I-Field: Two or more wells fields using permanent downhole sensors and valves that are used to maximise production of hydrocarbons and are linked to a central processing unit

Improved Oil Recovery (IOR): Extraction of crude oil or natural gas by any method other than those that rely primarily on natural reservoir pressure, gas lift, or a system of pumps **(Page 199)**

Intangible Drilling and Development Costs (IDC): Costs incurred in preparing well locations, drilling and deepening wells and preparing wells for initial production up through the point of installing control valves. None of these functions, because of their nature, have salvage value. Such costs would include labour, transportation, consumable supplies, drilling tool rentals, site clearance, and similar costs

Integrated: A firm that operates in both the upstream and downstream sectors (from exploration through refining and marketing) **(Page 37)**

Intercontinental Exchange (ICE): Operates regulated global futures exchanges and Over-the-Counter (OTC) markets for agricultural, energy, equity index and currency contracts, as well as credit derivatives **(Page 239)**

International Energy Association (IEA): An intergovernmental organisation based in Paris, France which acts as energy policy advisor to 28 member countries

in their effort to ensure reliable, affordable and clean energy for their citizens **(Page 277)**

IOCs: See **International Oil Companies (Page 38)**

IOR: See **Improved Oil Recovery (Page 199)**

Isobutane (C_4H_{10}): Normally gaseous branch-chain hydrocarbon. It is a colourless paraffinic gas that boils at a temperature of 10.9 °F. It is extracted from natural gas or refinery gas streams

Isobutylene (C_4H_8): Olefinic hydrocarbon recovered from refinery processes or petrochemical processes

Isohexane (C_6H_{14}): Saturated branch-chain hydrocarbon. It is a colourless liquid that boils at a temperature of 156.2°F

Isomers: Two or more chemical compounds having the same constituent elements in the same proportion by weight, but differing in physical or chemical properties because of differences in the structure of their molecules **(Page 59)**

Isomerisation: Refining process that alters the fundamental arrangement of atoms in the molecule without adding or removing anything from the original material. Used to convert: normal butane into isobutane (C_4), an alkylation process feedstock: and, normal pentane and hexane into isopentane (C_5) and isohexane (C_6) which are high-octane gasoline components

Isopentane: Saturated branched-chain hydrocarbon (C_5H_{12}) obtained by fractionation of natural gasoline or isomerisation of normal pentane

Isotopes: Forms of the same chemical element that differ only by the number of neutrons in their nucleus. Most elements have more than one naturally occurring isotope. Many isotopes have been produced in reactors and scientific laboratories **(Page 34)**

Jack-Up Platforms: These consist basically of a barge fitted with a support structure, or legs that when activated mechanically or hydraulically, are lowered until they reach the seabed. The platform is then raised above the water level to a safe height,

away from the action of the waves. These platforms are mobile and are pulled by tugboats or are self-propelled. They are designed to drill exploratory wells on the continental shelf in depths varying from 5 to 130 m **(Page 136)**

Jar: Downhole tool that produces a high-energy vibration or jolt to resolve stuck pipe

Jet Fuel: Refined petroleum product used in jet aircraft engines. It includes kerosene-type jet fuel and naphtha-type jet fuel

Jet Kero: See **Aviation Fuel (Page 284)**

JIP: See **Joint Industry Project (Page 145)**

Joint Implementation (JI): Agreements made between two or more nations under the auspices of the Framework Convention on Climate Change (FCCC) whereby a developed country can receive 'emissions reduction units' when it helps to finance projects that reduce net emissions in another developed country (including countries with economies in transition)

Joint Industry Project (JIP): RD project which has more than one oil company sponsoring the idea. This helps reduce the risk associated with new ideas and may help service companies find the funds necessary to complete the research **(Page 145)**

Joule (J): Metre-kilogram-second unit of work or energy, equal to the work done by a force of one Newton when its point of application moves through a distance of one metre in the direction of the force; equivalent to 107 ergs and one watt-second

Jurassic: One of three Mesozoic time periods: the Triassic (199-251 million years ago), the Jurassic (145-199 million years ago), and the Cretaceous (65-145 million years ago). The Jurassic and Cretaceous are relevant for oil and gas reservoirs. In the early Jurassic period in the Middle East, for example, the Hith, Arab, Jubaila, Diyab and Hanifa Formations can be found as well as North Sea fields and formations Kimmeridgian **(Page 31)**

Kerosene: A light petroleum distillate that is used in space heaters, cook stoves, and water heaters and is suitable for use as a light source when burned in wick-fed

lamps. Kerosene has a maximum distillation temperature of 204°C (400°F) at the 10% recovery point, a final boiling point of 572°F and a minimum flash point of 100°F. Included are No. 1-K and No. 2-K, the two grades recognised by ASTM Specification D 3699 as well as all other grades of kerosene called range or stove oil, which have properties similar to those of No. 1 fuel oil. Also see **Kerosene-Type Jet Fuel (Page 60)**

Kerosene-Type Jet Fuel: A kerosene-based product having a maximum distillation temperature of 400°F at the 10% recovery point and a final maximum boiling point of 572°F and meeting ASTM Specification D 1655 and Military Specifications MIL-T-5624P and MIL-T-83133D (Grades JP-5 and JP-8). It is used for commercial and military turbojet and turboprop aircraft engines

- Commercial: Kerosene-type jet fuel intended for use in commercial aircraft
- Military: Kerosene-type jet fuel intended for use in military aircraft

Ketone-Alcohol (Cyclohexanol): An oily, colourless, hygroscopic liquid with a camphor-like odour. Used in soapmaking, dry cleaning, plasticisers, insecticides and germicides

Key Performance Indicators (KPIs): Oil company measure of performance typically net worth, reserves to production ratio, reserves replacement, production quotas and positive cash-flow **(Page 37)**

Kilovolt-Ampere (kVa): A unit of apparent power, equal to 1,000 volt-amperes; the mathematical product of the volts and amperes in an electrical circuit

Kilowatt (kW): One thousand watts **(Page 264)**

Kilowatt-Electric (kWe): One thousand watts of electric capacity

Kilowatt Hour (kWh): A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1000 watts) of power expended for one hour. One kWh is equivalent to 3,412 Btu **(Page 317)**

Kinetic Energy: Energy available as a result of motion that varies directly in proportion to an object's mass and the square of its velocity **(Page 67)**

KPIs: See **Key Performance Indicators (Page 37)**

KW: See **Kilowatt (Page 264)**

KWe: See **Kilowatt-Electric**

KWh: See **Kilowatthour (Page 317)**

Kyoto Protocol: The result of negotiations at the third Conference of the Parties (COP-3) in Kyoto, Japan in December of 1997. The Kyoto Protocol sets binding GHG emissions targets for countries that sign and ratify the agreement. The gases covered under the protocol include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride **(Page 253)**

Landfill Gas: Gas that is generated by decomposition of organic material at landfill disposal sites. The average composition of landfill gas is approximately 50% methane and 50% carbon dioxide and water vapour by volume. The methane percentage, however, can vary from 40 to 60%, depending on several factors including waste composition (e.g. carbohydrate and cellulose content). The methane in landfill gas may be vented, flared, combusted to generate electricity or useful thermal energy on-site or injected into a pipeline for combustion elsewhere

Latitude and Longitude: Distance on the earth's surface measured, respectively, north or south of the equator and east or west of the standard meridian, expressed in angular degrees, minutes, and seconds

Leaded Gasoline: Fuel that contains more than 0.05 grams of lead per gallon or more than 0.005 grams of phosphorus per gallon

Leaded Premium Gasoline: Gasoline having an antiknock index (R+M/2) greater than 90 and containing more than 0.05 grams of lead or 0.005 grams of phosphorus per gallon

Leaded Regular Gasoline: Gasoline having an antiknock index (R+M/2) greater than or equal to 87 and less than or equal to 90 and containing more than 0.05 grams of lead or 0.005 grams of phosphorus per gallon

Lease: Legal document conveying the right to drill for oil and gas, or the tract of land on which a lease has been obtained where the producing wells and production equipment are located **(Page 27)**

Lifting Costs: Costs associated with the production of oil and gas reserves from an already producing property **(Page 43)**

Light-Duty Vehicles: Vehicles weighing less than 8500 pounds (includes automobiles, motorcycles, and light trucks)

Light Gas Oils: Liquid petroleum distillates heavier than naphtha, with an approximate boiling range from 205 °C (401 °F) to 343 °C (650 °F)

Light Rail: An electric railway with a 'light volume' traffic capacity compared to 'heavy rail'. Light rail may use exclusive or shared rights-of-way, high or low platform loading, and multi-car trains or single cars. Also known as 'street car', 'trolley car' and 'tramway'

Light Trucks: All single unit two-axle, four-tire trucks including pickup trucks, sport utility vehicles, vans, motor homes, etc. This is the US Department of Transportation definition. The EIA defines light truck as all trucks weighing 8500 pounds or less

Liquefied Natural Gas (LNG): Natural gas (primarily methane) that has been liquefied by reducing its temperature to -260°F at atmospheric pressure **(Page 87)**

Liquefied Petroleum Gas (LPG): Group of hydrocarbon-based gases derived from crude oil refining or natural gas fractionation. They include ethane, ethylene, propane, propylene, normal butane, butylene, isobutene and isobutylene. For convenience of transportation, these gases are liquefied through pressurisation **(Page 229)**

Liquefied Refinery Gases (LRG): LPGs fractionated from refinery or still gases. Through compression and/or refrigeration, they are retained in the liquid state. The reported categories are ethane/ethylene, propane/propylene, normal butane/butylene, and isobutane/isobutylene. Still gas is excluded

Lithosphere: The upper layer of the earth's surface that is broken up into numerous distinct tectonic plates which are moving, and this is exemplified by continental drift and seafloor spreading. This layer is quite rigid **(Page 19)**

LNG: See **Liquefied Natural Gas (Page 87)**

LNG Tankers: Used to safely transport LNG. Two main types are membrane or spherical tankers. The former has multiple tanks with linings made from thin nickel steel alloys capable of withstanding extreme temperatures. These tanks are integrated into the hull of the ship. The spherical design tanker has characteristic circular containment tanks that are structurally supported by beams on the hull of the ship **(Page 225)**

Log: A survey conducted inside a borehole to gather information about the subsurface formations; the results of such a survey. Logs typically consist of several curves on a long grid that describe properties within the wellbore or surrounding formations that can be interpreted to provide information about the location of oil, gas, and water. Also called well logs, borehole logs, wireline logs **(Page 31)**

Logging-While-Drilling(LWD): Outlines the requirements for cutting samples, mud logging and formation evaluation logging **(Page 163)**

LPG: See **Liquefied Petroleum Gas (Page 229)**

LRGs: See **Liquefied Refinery Gases**

LWD: See **Logging-While-Drilling (Page 163)**

Majors: Large integrated International Oil Companies (IOCs) operating worldwide such as Exxon Mobil, BP, Shell and Total **(Page 38)**

Manufactured Gas: A gas obtained by destructive distillation of coal, by the thermal decomposition of oil, or by the reaction of steam passing through a bed of heated coal or coke. Examples are coal gases, coke oven gases, producer gases, blast furnace gases, blue (water) gases and carburetted water gases. Btu content varies widely

Marine Mammal Observers (MMOs): Personnel that are trained to observe and identify marine mammals and other protected marine wildlife in the vicinity of a range of offshore operations. If the observer confirms that animals have breached the mitigation zone around the sound source, then under most conditions a source shutdown is required **(Page 156)**

Megawatt (MW): One million watts of electricity

Megawatt Electric (MWe): One million watts of electric capacity

Megawatthour (MWh): One thousand kilowatt-hours or 1 million watt-hours. **(Page 317)**

Mercaptan: Organic chemical compound that has a sulphur-like odour that is added to natural gas before distribution to the consumer to give it a distinct, unpleasant odour (smells like rotten eggs). This serves as a safety device by allowing it to be detected in the atmosphere in cases where leaks occur **(Page 58)**

Methane (CH_4): Colourless, flammable, odourless hydrocarbon gas which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a GHG. See also **Greenhouse Gases (Page 36)**

Methanogens: Bacteria that synthesise methane and require complete anaerobic conditions for growth

Methanol (CH_3OH): Light, volatile alcohol eligible for gasoline blending. **(Page 232)**

Methanol Blend: Mixtures containing 85% or more (or such other percentage, but not less than 70%) by volume of methanol with gasoline. Pure methanol is considered an 'alternative fuel'

Middle Distillates: General classification of refined petroleum products that includes distillate fuel oil and kerosene **(Page 305)**

Midstream: Industry activities that fall between exploration and production (upstream) and refining and marketing (downstream). The term is most often applied to pipeline transportation of crude oil and natural gas

Miles Per Gallon (MPG): Measure of vehicle fuel efficiency. Miles per gallon or MPG represents 'fleet miles per gallon'

Mineral: Naturally occurring inorganic substances such as metals, salt, sand, stone, sulphur, and water usually obtained from the earth. Note: For reporting on the US Financial Reporting System, the term also includes organic non-renewable substances that are extracted from the earth such as coal, crude oil and natural gas **(Page 17)**

Mineral Lease: Contract wherein a mineral interest owner (lessor) conveys to another party (lessee) the rights to explore for, develop and produce specified minerals. The lessee acquires a working interest and the lessor retains a non-operating interest in the property referred to as the royalty interest, each in proportions agreed upon

Mineral Rights: The ownership of the minerals beneath the earth's surface with the right to remove them. Mineral rights may be conveyed separately from surface rights

Mining: Energy-consuming subsector of the industrial sector that consists of all facilities and equipment used to extract energy and mineral resources **(Page 281)**

MMbbl/d: One million barrels of oil per day **(Page 38)**

MMBtu: One million British thermal units **(Page 285)**

MMcf: One million cubic feet **(Page 63)**

MMOs: See **Marine Mammal Observers (Page 156)**

Mole: Quantity of a compound or element that has a weight in grams numerically equal to its molecular weight. Also referred to as 'gram molecule' or 'gram molecular weight'

Montreal Protocol: The Montreal Protocol on Substances that Deplete the Ozone Layer (1987). An international agreement signed by most of the industrialised nations to substantially reduce the use of chlorofluorocarbons (CFCs). Signed in January 1989, the original document called for a 50% reduction in CFC use by 1992 relative to 1986 levels. The subsequent London Agreement called for a complete elimination of CFC use by 2000. The Copenhagen Agreement, which called for a complete phase-out by January 1, 1996 was implemented by the US Environmental Protection Agency

Motor Gasoline Blending: Mechanical mixing of motor gasoline blending components, and oxygenates, when required, to produce finished motor gasoline. This gasoline may be further mixed with other motor gasoline blending components or oxygenates, resulting in increased volumes of finished motor gasoline and/or changes in the formulation of finished motor gasoline (e.g., conventional motor gasoline mixed with ethanol to produce oxygenated motor gasoline)

Motor Gasoline Blending Components: Naphthas (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, xylene) used for blending or compounding into finished motor gasoline. These components include Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB) but exclude oxygenates (alcohols, ethers), butane, and pentanes plus. Note: Oxygenates are reported as individual components and are included in the total for other hydrocarbons, hydrogens and oxygenates

MPG: See **Miles per Gallon**

Mud (Drilling Mud): A combination of fluid used to cool drill bits and help prevent natural gas and oil from escaping from boreholes and solids (cuttings) from the wellbore which may also be known as 'returns' **(Page 22)**

Multilateral (Multiple Completion Well): A well equipped to produce oil and/or gas separately from more than one reservoir co-mingled into a single motherbore. Such wells contain multiple strings of tubing or other equipment that permit production from the various completions to be measured and accounted for separately **(Page 89)**

Multilateral Wells: Several wellbores stretching out from a central hole called the motherbore. Such 'branches' can reach smaller pockets of oil or gas buried within the rock **(Page 189)**

MW: See **Megawatt**

MWe: See **Megawatt Electric**

MWh: See **Megawatthour**

Naphtha: Generic term applied to a petroleum fraction with an approximate boiling range between 122 °F and 400 °F **(Page 231)**

Naphtha-Type Jet Fuel: Fuel in the heavy naphtha boiling range having an average gravity of 52.8°API, 20 to 90% distillation temperatures of 290° to 470°F, and which meet Military Specification MIL-T-5624L (Grade JP-4). It is used primarily for military turbojet and turboprop aircraft engines because it has a lower freezing point than other aviation fuels and meets engine requirements at high altitudes and speeds

National Oceanic and Atmospheric Administration (NOAA): A federal agency focused on the condition of the oceans and the atmosphere **(Page 252)**

National Oil Company (NOC): Oil company part or fully owned by a sovereign or nation state **(Page 116)**

Natural Gas Hydrates: Solid, crystalline, wax-like substances composed of water, methane, and usually a small amount of other gases, with the gases being trapped in the interstices of a water-ice lattice. They form beneath permafrost and on the ocean floor under conditions of moderately high-pressure and at temperatures near the freezing point of water

Natural Gas Liquids (NGL): Natural Gas Liquids (NGLs): Hydrocarbons in natural gas separated from the gas as liquids through the process of absorption, condensation, adsorption, or other methods in gas processing or cycling plants. Generally, such liquids consist of propane and heavier hydrocarbons and are commonly referred to as lease condensate, natural gasoline, and LPGs. NGLs include natural gas plant liquids (primarily ethane, propane, butane, and isobutane; see Natural Gas Plant Liquids) and lease condensate (primarily pentanes produced from natural gas at lease separators and field facilities; see **Lease Condensate**) **(Page 43)**

Natural Gas Liquids Production: Volume of natural gas liquids removed from natural gas in lease separators, field facilities, gas processing plants, or cycling plants during the report year

Natural Gas Plant Liquids: Hydrocarbons in natural gas that are separated as liquids at natural gas processing plants, fractionating and cycling plants and, in some

instances, field facilities. Lease condensate is excluded. Products obtained include ethane; LPGs (propane, butanes, propane-butane mixtures, ethane-propane mixtures); isopentane; and other small quantities of finished products such as motor gasoline, special naphthas, jet fuel, kerosene, and distillate fuel oil **(Page 279)**

Natural Reservoir Pressure: Natural energy or 'pressure' contained within an oil or gas reservoir that causes oil or gas to rise to the wellhead when the reservoir is connected to an oil or gas well by means of drilling. The energy may be the result of 'dissolved gas drive', 'gas cap drive' or 'water drive'. Regardless of the type of drive, the principle is the same: the energy of the gas or water, creating a natural pressure, forces the oil or gas to the well bore. Once the natural reservoir has been depleted primary, secondary and tertiary means of recovery may be employed

New Field Discoveries: Volumes of proved reserves of crude oil, natural gas, and/or NGLs discovered in new fields during the report year

New York Mercantile Exchange (NYMEX): Regulated financial market trading in metals and petroleum futures and options **(Page 239)**

NGL: See **Natural Gas Liquids (Page 43)**

NOAA: See **National Oceanic and Atmospheric Administration (Page 252)**

NOAA Division: One of the 345 weather divisions designated by the National Oceanic and Atmospheric Administration (NOAA) encompassing the 48 contiguous states. These divisions usually follow county borders to encompass counties with similar weather conditions. The NOAA division does not follow county borders when weather conditions vary considerably within a county; such is likely to happen when the county borders the ocean or contains high mountains. A state contains an average of seven NOAA divisions; a NOAA division contains an average of nine counties

NOC: See **National Oil Company (Page 116)**

Non-Associated Gas: Gas produced from a reservoir that does not contain significant quantities of crude oil

Non-Renewable Fuels: Sources of energy that cannot be renewed such as oil, natural gas, and coal. Note: gas may be biologically produced

Nuclear Electric Power (Nuclear Power): Electricity generated by the use of the thermal energy released from the fission of nuclear fuel in a reactor **(Page 260)**

Nuclear Fuel: Fissionable materials that have been enriched to such a composition that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction producing heat in a controlled manner for process use **(Page 261)**

Nuclear Reactor: Apparatus in which a nuclear fission chain reaction can be initiated, controlled and sustained at a specific rate. A reactor includes: fuel (fissionable material), moderating material to control the rate of fission; a heavy-walled pressure vessel to house reactor components; shielding to protect personnel; a system to conduct heat away from the reactor; and instrumentation for monitoring and controlling the reactor's systems **(Page 261)**

NYMEX: See **New York Mercantile Exchange (Page 239)**

OCS: See **Outer Continental Shelf**

Octane: Flammable liquid hydrocarbon found in petroleum. Used as a standard to measure the anti-knock properties of motor fuel **(Page 63)**

Octane Rating: Number used to indicate gasoline's antiknock performance in motor vehicle engines. The two recognised laboratory engine test methods for determining the antiknock rating, i.e., octane rating, of gasoline are the research method and the motor method. To provide a single number as guidance to the consumer, the antiknock index (R + M)/2, which is the average of the Research and Motor octane numbers, was developed

OECD: See **Organisation for Economic Co-operation and Development (Page 253)**

Offshore: Denotes geographic area that lies under sea or any other stretch of water. In general, shallow waters near the coastline or deltas are referred to as 'shelf'. Waters beyond this are known as 'deepwaters' **(Page 18)**

Oil: A liquid fossil fuel whose colour changes according to density and viscosity. It is found deep underground and is the raw material used to make petroleum products and derivatives **(Page 17)**

Oil Initially in Place: The total resource base of subterreanean oil and gas formed and trapped in place within the earth before any production begins **(Page 40)**

Oil Reservoir: Underground accumulation of liquids and gases consisting of hydrocarbons, sulphur, oxygen and nitrogen trapped within a geological formation and protected from evaporation by an overlying impermeable cap rock **(Page 53)**

Oil Rig: A structure containing the equipment needed for drilling oil and the accommodation for the rig crew

Oil Shale: Sedimentary rock containing kerogen, a solid organic material **(Page 43)**

Oil Stocks: Oil stocks include crude oil (including strategic reserves), unfinished oils, natural gas plant liquids and refined petroleum products **(Page 241)**

Oil Tankers: Make up many of the world's largest ships; hence, the common term 'supertanker' referring to Ultra Large Crude Carriers, a few of which can carry 3.5 million barrels of oil **(Page 224)**

Oil Well: A well completed for the production of crude oil from at least one oil zone or reservoir **(Page 182)**

Oil Well Gas: See **Casing-Head Gas**

OPEC: See **Organisation of the Petroleum Exporting Countries (Page 38)**

Operator, Oil and/or Gas Well: Entity responsible for the management and day-to-day operation of one or more crude oil and/or natural gas wells **(Page 52)**

Organisation for Economic Co-operation and Development (OECD): International organisation helping governments tackle the economic, social and governance challenges of a globalised economy. Its membership comprises about

30 member countries. With active relationships with 70 other countries, NGOs and civil society, it has a global reach. For details about the organisation, visit http://www.oecd.org **(Page 253)**

Organisation of the Petroleum Exporting Countries (OPEC): A permanent intergovernmental organisation, created at the Baghdad Conference on September 10-14, 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. The five Founding Members were later joined by nine other Members: Qatar (1961); Indonesia (1962); Socialist Peoples Libyan Arab Jamahiriya (1962); United Arab Emirates (1967); Algeria (1969); Nigeria (1971); Ecuador (1973) suspended its membership from December 1992-October 2007; Angola (2007); and Gabon (1975–1994) **(Page 38)**

Outer Continental Shelf (OCS): A term used primarily in the US for the offshore areas under federal jurisdiction

Overburden: Material, consolidated or unconsolidated, that overlies an oil and gas reservoir and causes an overburden pressure **(Page 23)**

Ozone: Molecule made up of three atoms of oxygen. Occurs naturally in the stratosphere and provides a protective layer shielding the earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant, a GHG and a major component of photochemical smog **(Page 250)**

Palaeontologist: A person who studies fossilised or preserved remnants of animal or plant life **(Page 34)**

Paleomagnetics: Studies the residual effect of magnetic polarity, changes in the earth's evolution where the earth's magnetic poles swapped polarity back and forth over eons of time **(Page 33)**

Palynology: The study of fossil pollen and spores **(Page 34)**

Paper Barrels: The trade and speculation involving paper oil or gas barrels that are not delivered physically as opposed to wet barrels that are physical commodities for delivery **(Page 237)**

Peak Oil: Theory that regards global petroleum reserves as having peaked, that further large finds are unlikely and global production is declining. The view of the

author is today's theories regarding petroleum reserves and recoverability are incomplete. Knowledge increases over time while many prospective petroleum plays are unexplored; therefore, all known sources of petroleum systems have not yet been quantified, 'the medieval map' **(Page 37)**

Permeability: Measure of the ability of a fluid to 'seep' or 'flow' through a given formation, reported in Darcies **(Page 23)**

Persian Gulf: The countries that surround the Persian Gulf. They are Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates **(Page 50)**

Petrochemical: Organic and inorganic compounds and mixtures that include but are not limited to organic chemicals, cyclic intermediates, plastics and resins, synthetic fibres, elastomers, organic dyes, organic pigments, detergents, surface active agents, carbon black and ammonia **(Page 81)**

Petrochemical Feedstocks: Chemical feedstocks derived from petroleum principally for the manufacture of chemicals, synthetic rubber and a variety of plastics

Petroleum: Catch-all term for liquid hydrocarbon mixtures including crude oil, condensate, unfinished oils, refined products obtained from the processing of crude oil and natural gas plant liquids. The term comes from the Latin words 'petra' ('rock') and 'oleum' ('oil') **(Page 23)**

Petroleum Coke, Catalyst: Carbonaceous residue that is deposited on and deactivates the catalyst used in many catalytic operations (e.g., catalytic cracking). Carbon is deposited on the catalyst, thus deactivating the catalyst. The catalyst is reactivated by burning off the carbon, which is used as a fuel in the refining process. That carbon or coke is not recoverable in a concentrated form **(Page 79)**

Petroleum Coke, Marketable: Grades of coke produced in delayed or fluid cokers that may be recovered as relatively pure carbon. Marketable petroleum coke may be sold as is or further purified by calcining **(Page 267)**

Petroleum, Inventory of Stocks: Considered a fundamental market indicator and an indirect measure of oil price as it indicates how oil demand and supply is balanced

Petroleum Jelly: Semi-solid oily product produced from de-waxing lubricating oil basestocks

Petroleum Products: Petroleum products are obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Petroleum products include unfinished oils, LPGs, pentanes plus, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas and miscellaneous products **(Page 124)**

Petroleum Refinery: Installation that manufactures finished petroleum products from crude oil, unfinished oils, NGLs, other hydrocarbons and alcohol

Petroleum Stocks, Primary: Individual products, quantities of which are held at refineries, in pipelines and at bulk terminals that have a capacity of 50,000 barrels or more, or that are in transit thereto. Stocks held by product retailers and resellers, as well as tertiary stocks held at the point of consumption, are excluded. Stocks of individual products held at gas processing plants are excluded from individual product estimates but are included in other oil estimates and totals

Phase: A homogeneous body of material which differs in its intensive properties from its neighbouring phases **(Page 60)**

Photon: A particle of light that acts as an individual unit of energy

Photovoltaic (or Solar cell): Device that converts some of the energy from light (radiant energy) into electrical energy **(Page 262)**

Photovoltaic and Solar Thermal Energy (as used at electric utilities): Energy radiated by the sun as electromagnetic waves (electromagnetic radiation) that is converted at electric utilities into electricity by means of solar (photovoltaic) cells or concentrating (focusing) collectors

Photovoltaic Cell (PVC): An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts. It is capable of converting incident light directly into electricity (direct current) **(Page 229)**

Pigging Technology: Geometric and magnetic instrumented pig technologies are tools used for the internal inspection of pipelines, with the objective of assuring pipeline integrity and flow as well as to reduce risks, avoid emergency shut-downs and to reduce operational costs **(Page 221)**

Pipeline: Most common form of transporting crude oil, natural gas, refined products, derivatives and ethanol. Pipelines comprise a network of pipe tubes complete with such equipment as valves, compressor stations, communications systems and metres for transporting hydrocarbons or other products from one point to another **(Page 35)**

Pipeline, Distribution: Pipeline that conveys gas from a transmission pipeline to its ultimate consumer

Pipeline Fuel: Gas consumed in the operation of pipelines, primarily in compressors

Pipeline, Gathering: Pipeline that conveys gas from a production well/field to a gas processing plant or transmission pipeline for eventual delivery to end-use consumers

Pipeline (Petroleum): Crude oil and product pipelines used to transport crude oil and petroleum products

Plate Tectonics: The unifying geologic theory developed to explain observations that interactions of the brittle plates of the lithosphere with each other and with the softer underlying asthenosphere result in large-scale changes in the earth **(Page 19)**

Plugged and Abandoned (P&A): Uneconomic/depleted well or dry hole that has been filled with cement and has had all surface equipment removed

Polyvinyl Chloride (PVC): Polymer of vinyl chloride. Tasteless, odourless and insoluble in most organic solvents. A member of the vinyl resin family that is used in soft flexible films for food packaging and in moulded rigid products such as pipes, fibres, upholstery and bristles **(Page 229)**

Pores: A discrete void within a rock, which can contain air, water, hydrocarbons or other fluids **(Page 26)**

Pore Pressure Fracture Gradient (PPFG): Deepwaters often have young depositional formations that differ from shelf and onshore scenarios. Narrow windows PPFGs exist and low fracture gradients may necessitate lighter drilling fluids and lighter cement slurry, while rising pore pressures may destabilise the well-bore and jeopardise the section, if not the entire well **(Page 159)**

Pore Space: The open spaces or voids within a rock taken collectively. It is a measure of the amount of liquid or gas that may be absorbed or yielded by a particular formation **(Page 27)**

Porosity: A ratio between the volume of the pore space in reservoir rock and the total bulk volume of the rock. The pore space determines the amount of space available for storage of fluids **(Page 23)**

Power: Rate at which energy is transferred. Electrical energy is usually measured in watts, a unit also used as a measurement of capacity **(Page 25)**

PPFG: See **Pore Pressure Fracture Gradient (Page 159)**

Pregnant Lady: Complex 3D well profile resembling the profile of a pregnant lady **(Page 153)**

Pressure-While-Drilling Tools: Can replace wireline or pipe-conveyed logging services and are made up as part of the BHA. This allows operators to measure formation pressure as it is encountered which improves well control, safety and drilling efficiency **(Page 163)**

Probable Energy Reserves: Estimated quantities of energy sources that, on the basis of geologic evidence that supports projections from proved reserves (see definition below), can reasonably be expected to exist and be recoverable under existing economic and operating conditions. Site information is insufficient to establish with confidence the location, quality, and grades of the energy source. Note: This term is equivalent to 'indicated reserves' as defined in the resource/reserve classification contained in the US Geological Survey Circular 831, 1980. Measured and indicated reserves, when combined, constitute demonstrated reserves

Processing Gain: Volumetric amount by which total output is greater than input

for a given period of time. This difference is due to the processing of crude oil into products which, in total, have a lower specific gravity than the crude oil processed

Processing Loss: Volumetric amount by which total refinery output is less than the input for a given period of time. This difference is due to the processing of crude oil into products which, in total, have a higher specific gravity than the crude oil processed

Produced Water: Water produced at the surface in conjunction with oil and gas. It may include water from the reservoir, water that has been injected into the formation and any chemicals added during the production/treatment process. Produced water is also called 'brine' (and may contain high mineral or salt content) or 'connate water' **(Page 61)**

Producing Gas-Oil Ratio (GOR): The ratio of gas production rate to crude oil production rate expressed as volume/volume, e.g. cubic feet per barrel measured under standard conditions **(Page 59)**

Production Capacity: The amount of product that can be produced from processing facilities **(Page 35)**

Production Costs: Costs incurred to operate and maintain wells and related equipment and facilities, including depreciation and applicable operating costs of support equipment and facilities and other costs of operating and maintaining those wells and related equipment and facilities. They become part of the cost of oil and gas produced. The following are examples of production costs (sometimes called lifting costs): costs of labour to operate the wells and related equipment and facilities; repair and maintenance costs; the costs of materials, supplies, and fuels consumed and services utilised in operating the wells and related equipment and facilities; the costs of property taxes and insurance applicable to proved properties and wells and related equipment and facilities; and, the costs of severance taxes

Depreciation, Depletion, and Amortisation (DD&A) of capitalised acquisition, exploration, and development costs are not production costs, but also become part of the cost of oil and gas produced along with production (lifting) costs identified above. Production costs include the following subcategories of costs: well workers

and maintenance; operating fluid injections and improved recovery programs; operating gas processing plants; ad valorem taxes; production or severance taxes. **(Page 48)**

Production, Crude Oil: The volumes of crude oil that are extracted from oil reservoirs. These volumes are determined through measurement of the volumes delivered from lease storage tanks or at the point of custody transfer, with adjustment for the net differences between opening and closing lease inventories. Crude oil used on the lease is considered production **(Page 27)**

Production, Natural Gas: Volume of natural gas withdrawn from reservoirs: the volume returned to such reservoirs in cycling, repressuring of oil reservoirs, and conservation operations; shrinkage resulting from the removal of lease condensate; and, non-hydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Volumes of gas withdrawn from gas storage reservoirs and native gas, which has been transferred to the storage category, are not considered production. Flared and vented gas is also considered production. (This differs from 'marketed production' which excludes flared and vented gas) **(Page 28)**

Production, Oil and Gas: Lifting of oil and gas to the surface and gathering, treating, field processing (as in the case of processing gas to extract liquid hydrocarbons), and field storage. Production is regarded as terminating at the outlet valve on the lease or field production storage tank. If unusual physical or operational circumstances exist, it may be more appropriate to regard the production function as terminating at the first point at which oil, gas, or gas liquids are delivered to a main pipeline, a common carrier, a refinery, or a marine terminal **(Page 25)**

Production Payments: A contractual arrangement providing a mineral interest that gives the owner a right to receive a fraction of production, or of proceeds from the sale of production, until a specified quantity of minerals (or a definite sum of money, including interest) has been received

Production Plant Liquids: The volume of liquids removed from natural gas in natural gas processing plants or cycling plants during the year

Production, Primary (Artificial Lift): Methods used to increase oil and gas production include the nodding donkey or rod pump, Electrical Submersible Pump (ESP) or a gas-lift system. During primary recovery, only a small percentage of the

initial hydrocarbons in place are produced, typically around 10% for oil reservoirs and 15% for gas reservoirs **(Page 179)**

Production, Secondary: Refers to production that is achieved when a fluid such as water or gas is injected into the reservoir through injection wells to restore pressure **(Page 25)**

Production, Tertiary or Enhanced Oil Recovery (EOR): Not only restores formation pressure but also seeks to improve reservoir flow characteristics. This may include chemical, microbial, steam or combustion methods **(Page 70)**

Propane (C_3H_8): A normally gaseous straight-chain hydrocarbon. It is a colourless paraffinic gas that boils at a temperature of -42 °C (-43.67 °F). It is extracted from natural gas or refinery gas streams **(Page 63)**

Proppant: Sized particles mixed with fracturing fluid to hold fractures open after a hydraulic fracturing treatment **(Page 170)**

Proved Energy Reserves: Estimated quantities of energy sources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions. The location, quantity, and grade of the energy source are usually considered to be well established in such reserves. Note: This term is equivalent to 'measured reserves' as defined in the resource/reserve classification contained in the US Geological Survey Circular 831, 1980. Measured and indicated reserves, when combined, constitute demonstrated reserves **(Page 318)**

Proven Reserves: Represent the certainty that an oil reserve exists based on geologic and engineering data from the site **(Page 44)**

Pseudo-Critical Pressure and Temperature: A fictitious critical pressure and temperature value ascribed to a multi-component system in order that the reduced pressure-volume-temperature states of the system conform to the reduced states of pure gases

P value: Corresponding to a value, i.e. P 90, P 50 or P 10. The 'P' factor simply represents the percentage chance of reserves being produced - Proved 90%, Probable 50% and Possible 10% **(Page 42)**

PVC: See **Photovoltaic Cell (Page 229)** or **Polyvinyl Chloride (Page 231)**

PWD Tools: See **Pressure-While-Drilling Tools (Page 163)**

Quadrillion: The quantity 1,000,000,000,000,000 (10 to the 15th power). **(Page 278)**

R & D: See **Research and Development (Page 86)**

Rankine Cycle: The thermodynamic cycle that is an ideal standard for comparing the performance of heat-engines, steam power plants, steam turbines, and heat pump systems that use a condensable vapour as the working fluid. Efficiency is measured as work done divided by sensible heat supplied

Rankine Cycle Engine: The Rankine cycle system uses a liquid that evaporates when heated and expands to produce work such as turning a turbine, which when connected to a generator, produces electricity. The exhaust vapour expelled from the turbine condenses and the liquid is pumped back to the boiler to repeat the cycle. The working fluid most commonly used is water, though other liquids can also be used. Rankine cycle design is used by most commercial electric power plants. The traditional steam locomotive is also a common form of the Rankine cycle engine. The Rankine engine itself can be either a piston engine or a turbine

Real-Time Operations (RTO): Advanced monitoring and alerting functionality enabling oil company or service personnel to instantly identify, respond to and resolve issues as they arise. Better information leads to better decisions thereby saving time and money **(Page 108)**

Recoverable Proved Reserves: Proved reserves of natural gas as of December 31 of any given year are the estimated quantities of natural gas which geological and engineering data demonstrates with reasonable certainty to be recoverable in the future from known natural oil and gas reservoirs under existing economic and operating conditions

Refinery: Industrial plant that heats crude oil (petroleum) to separate it into fractions which are made into finished petroleum products **(Page 62)**

Refinery and Blender Net Inputs: Raw materials, unfinished oils, and blending components processed at refineries, or blended at refineries or petroleum storage terminals, to produce finished petroleum products

Refinery and Blender Net Production: Liquefied refinery gases and finished petroleum products produced at a refinery or petroleum storage terminal blending facility

Refinery Capacity Utilisation: Ratio of the total amount of crude oil, unfinished oils, and natural gas plant liquids run through crude oil distillation units to the operable capacity of these units

Refinery Fuel: Crude oil and petroleum products consumed at the refinery for all purposes

Refinery Gas: Non-condensate gas collected in petroleum refineries

Refinery-Grade Butane: A refinery produced stream that is composed predominantly of normal butane and/or isobutane and may also contain propane and/or natural gasoline. These streams may also contain significant levels of olefins and/or fluorides contamination

Refinery Input, Crude Oil: Total crude oil (domestic plus foreign) input to crude oil distillation units and other refinery processing units (e.g. cokers, etc.)

Refinery Input, Total: The raw materials and intermediate materials processed at refineries to produce finished petroleum products. They include crude oil, products of natural gas processing plants, unfinished oils, other hydrocarbons and oxygenates, motor gasoline and aviation gasoline blending components and finished petroleum products

Refinery Losses and Gains: Processing gain and loss that takes place during the refining process itself. Excludes losses that do not take place during the refining process, e.g., spills, fire losses and contamination during blending, transportation, or storage

Refinery Output: The total amount of petroleum products produced at a refinery. Includes petroleum consumed by the refinery

Refinery Production: Petroleum products produced at a refinery or blending plant. Published production of these products equals refinery production minus refinery input

Refinery Utilisation Rate: Represents the use of the atmospheric crude oil distillation units. The rate is calculated by dividing the gross input to the units by the operable refining capacity of the units

Refinery Yield: Represents the percent of finished product produced from input of crude oil and net input of unfinished oils. It is calculated by dividing the sum of crude oil and net unfinished input into the individual net production of finished products

Renewable Energy: Energy resources that can be easily 'renewed' or made. Forms of renewable energy include solar, wind, biomass, hydroelectricity and geothermal energy **(Page 249)**

Research and Development (R & D): Basic and applied research in the sciences and engineering and the design and development of prototypes and processes excluding quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, and other non-technological activities or technical services **(Page 86)**

Reserves: Oil and gas that has not been produced. SEC and SPE reserves criteria are used to measure reserves. A sliding scale of the 'probability' or percentage chance of production exists. Proved, Probable and Possible reserves indicate the ease or difficulty of production. A numerical 'P' value represents the specific probability of the reserves being produced. Typically, P values for ultimate recovery range from P90 for a very high probability, P50 for medium probability and P10 for a very low probability **(Page 27)**

Reservoir Characterisation: How the reservoir will behave under production. Includes petrophysical parameters **(Page 28)**

Reservoir Description: The means by which the reservoir is described using observable parameters **(Page 28)**

Reservoir Stimulation: A synthetic way to increase porosity and/or permeability **(Page 27)**

Rig: Machine and equipment used to drill a wellbore. In onshore operations, the rig includes virtually everything except living quarters. Major components of the rig include the mud tanks; mud pumps; derrick or mast; drawworks; rotary table or top-drive; drillstring; power generation equipment; and, auxiliary equipment. Offshore, the rig includes the same components as onshore, but not those of the vessel or drilling platform itself. The rig is sometimes referred to as the drilling package, particularly when offshore **(Page 19)**

Riser: In deepwater drilling the riser connects the surface rig to the seabed wellhead or seabed operations **(Page 47)**

Rotary Drilling: Efficient means of drilling that uses rotating bit and weight to cut or crush rock. As the bit rotates continuously and has nozzles for fluid exit, cuttings are constantly swept away while fluid circulates through the bit and up the wellbore **(Page 175)**

Royalty: Contractual arrangement providing a mineral interest that gives the owner a right to a fractional share of production or proceeds thereof, that does not contain rights and obligations of operating a mineral property, and that is normally free and clear of exploration, developmental and operating costs (except production taxes) **(Page 137)**

RTO: See **Real-Time Operations (Page 108)**

SAGD: See **Steam-Induced Gravity Drainage (Page 205)**

Saturated Liquid: A liquid which is in equilibrium with vapour at a given pressure and temperature state

Saturated Vapour: A vapour which is in equilibrium with a liquid at a given pressure and temperature state

Saturation Pressure: Pressure at which vapour and liquid are in equilibrium (also bubble point pressure or dew point pressure)

SCADA: See **Supervisory Control and Data Acquisition (Page 218)**

Sea Surface Height (SSH): Height (or topography or relief) of the ocean's surface **(Page 185)**

Sea Surface Temperature (SST): The water temperature close to the surface **(Page 185)**

SEC: See **Securities Exchange Commission (Page 39)**

Securities Exchange Commission (SEC): US Governmental body designed to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation **(Page 39)**

Sediment: Minute particles of rock, earth and other debris that are deposited into rivers which run to the sea **(Page 17)**

Sedimentary Rocks: Rocks formed by the accumulation of sediment in water or air. There are three different types:

- Siliclastic: Formed by the accumulation of mostly silicate mineral fragments
- Chemical: Formed by direct chemical precipitation from water
- Biogenic: Consists of fragments of particles produced by precipitation from once-living organisms **(Page 18)**

Sedimentologist: An individual who examines sediment to discover their nature and the environments in which they accumulated **(Page 29)**

Seeps: A place where water, petroleum or tar seeps out of the ground **(Page 24)**

Seismic Survey: A method of finding oil and natural gas by measuring the time it takes acoustic shock waves to travel through layers of earth, reflect back from oil deposits and be detected at surface **(Page 29)**

Semi-Conductors: Substances, such as silicon or germanium, that conduct electricity at a lower rate than metals, but at a higher rate than insulators. These substances are the basic components of various kinds of electronic circuits

Semi-Submersible Platforms: Semi-submersible platforms consist of a structure of one or more decks supported by submerged pontoons. A pontoon moves in accordance with the action of waves, currents and winds, and this may damage the equipment that is to be lowered into the well. That is why it must be set in position on the surface of the sea, within a tolerance radius dictated by the sub-surface equipment **(Page 136)**

Separation: The process of separating liquid and gas hydrocarbons and water. This is typically accomplished in a pressure vessel at the surface, but newer technologies allow separation to occur in the wellbore under certain conditions **(Page 36)**

Service Well: A well drilled, completed, or converted for the purpose of supporting production in an existing field. Wells of this class also are drilled or converted for the following specific purposes: gas injection (natural gas, propane, butane or fuel-gas); water injection; steam injection; air injection; salt water disposal; water supply for injection; observation; and, injection for in-situ combustion

Shrinkage: The decrease in volume of liquid petroleum caused by the release of solution gas and/or by the thermal contraction of the liquid. The shrinkage may be expressed as a percentage of the stock tank volume or a percentage of the reservoir oil volume **(Page 69)**

Shrinkage Factor: The reciprocal of formation volume factor expressed as barrels of stock tank oil per barrel of reservoir oil

Shut In: Closed temporarily; wells and mines capable of production may be shut in for repair, cleaning, inaccessibility to a market, etc. **(Page 140)**

Shut-in Royalty: Paid by a lessee as compensation for a lessor's loss of income because the lessee has deferred production from a property that is known to be capable of producing minerals. Shut in may be caused by a lack of a ready market, by a lack of transportation facilities, or by other reasons. A shut-in royalty may or may not be recoverable out of future production

Sidetrack Drilling: Remedial operation that results in the creation of a new section of well bore for the purpose of: detouring around junk or stuck-fish; redrilling lost holes; or, straightening key seats and crooked holes. Directional 'side-track' wells do

not include footage in the common bore that is reported as footage for the original well

Sludge: A dense, slushy, liquid-to-semifluid product that accumulates as an end result of an industrial or technological process designed to purify a substance. Industrial sludges are produced from the processing of energy-related raw materials, chemical products, water, mined ores, sewage and other natural and man-made products. Sludges can also form from natural processes such as the run-off produced by rain fall that accumulates on the bottom of bogs, streams, lakes, and tidelands **(Page 268)**

SOBM: See **Synthetic Oil-Based Mud (Page 195)**

Society of Petroleum Engineers (SPE): A trade organisation focusing on promoting improved knowledge of petroleum engineering worldwide **(Page 39)**

Solar Energy: Radiated by the sun which can be converted into other forms of energy such as heat or electricity **(Page 262)**

Solar Panels: A collection of solar cells used to draw heat from the sun **(Page 262)**

Solution Gas-Oil Ratio (Dissolved Gas-Oil Ratio): The volume ratio obtained by dividing the amount of gas which would be liberated from a system existing originally as a liquid by the liquid remaining after the system is reduced to standard atmospheric conditions

Source Rock: The origin of hydrocarbon formation based on deposits of organic matter converted to hydrocarbons within a given rock or formation. Even today the formation of oil and gas as a process is not fully understood but the prevalent theory is that time, pressure and heat convert decomposed marine life into oil and gas **(Page 23)**

Sour Crude Oil: Oil containing free sulphur or other sulphur compounds whose total sulphur content is in excess of 1%

Sour Gas: Natural gas containing hydrogen sulphide **(Page 204)**

Spacing: Distance between wells producing from the same reservoir. Spacing is often expressed in terms of acres, e.g., 40-acre spacing, and is often established by regulatory agencies **(Page 171)**

Spare (Excess) Capacity: Generally refers to countries such as Saudi Arabia which have sought to provide a soft landing mechanism by maintaining excess production capacity; the so-called supply cushion **(Page 113)**

SPE: See **Society of Petroleum Engineers (Page 39)**

Spent Fuel: Irradiated fuel that is permanently discharged from a reactor. Except for possible reprocessing, this fuel must eventually be removed from its temporary storage location at the reactor site and placed in a permanent repository. Spent fuel is typically measured either in metric tonnes of heavy metal (i.e., only the heavy metal content of the spent fuel is considered) or in metric tonnes of initial heavy metal (essentially, the initial mass of the fuel before irradiation). The difference between these two quantities is the weight of the fission products **(Page 260)**

Spent Fuel Disassembly Hardware: The skeleton of a fuel assembly after the fuel rods have been removed

Spot Price: The price for a one-time open market transaction for near-term delivery of a specific quantity of product at a specific location where the commodity is purchased 'on the spot' at current market rates

Spot Purchases: A single shipment of fuel or volumes of fuel purchased for delivery within a year. Spot purchases are often made by a user to fulfill a certain portion of energy requirements, to meet unanticipated energy needs or to take advantage of low-fuel prices

SPR: See **Strategic Petroleum Reserve**

SSH: See **Sea Surface Height (Page 185)**

SST: See **Sea Surface Temperature (Page 185)**

Standard Conditions: Standard Conditions are generally a temperature of 15°C (60°F) and a pressure of 14.7 psia (1 bar) **(Page 62)**

Steam Assisted Gravity Drainage (SAGD): An EOR technology for producing heavy crude oil and bitumen. It is an advanced form of steam stimulation in which a pair of horizontal wells is drilled into the oil reservoir, one a few metres above the other. Low pressure steam is continuously injected into the upper wellbore to heat the oil and reduce its viscosity, causing the heated oil to drain into the lower wellbore, where it is pumped out. **(Page 205)**

Still Gas (Refinery Gas): Any form or mixture of gases produced in refineries by distillation, cracking, reforming and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylene, propane, propylene, etc. Still gas is used as a refinery fuel and a petrochemical feedstock. The conversion factor is six million Btus per fuel oil equivalent barrel

Stimulation: Term used for several processes to enlarge old channels, or create new ones, in the producing formation of a well designed to enhance production. Examples include acidising and fracturing **(Page 27)**

Stock Tank Oil: Crude oil in equilibrium with a portion of its evolved gases at standard atmospheric conditions

Strategic Petroleum Reserve (SPR): Petroleum stocks maintained by the US federal government for use during periods of major supply interruption

Stratigraphic Test Well: A geologically directed drilling effort to obtain information pertaining to a specific geological condition that might lead toward the discovery of an accumulation of hydrocarbons. Such wells are customarily drilled without the intention of being completed for hydrocarbon production. This classification also includes tests identified as core tests and all types of expendable holes related to hydrocarbon exploration

Stratigraphy: The study of the history, composition, relative ages and distribution of strata, and the interpretation of strata **(Page 29)**

Stratosphere: Region of the upper atmosphere extending from the troposphere (8 to 15 kilometres altitude) to about 50 kilometres. Its thermal structure, which is determined by its radiation balance, is generally very stable with low humidity

Streamer: A surface marine cable, usually a buoyant assembly of electrical wires, that connects hydrophones and relays seismic data to the recording seismic vessel **(Page 157)**

Stripper Well: An oil or gas well that produces at relatively low rates. For oil, stripper production is usually defined as production rates of between 5 and 15 barrels of oil per day. Stripper gas production would generally be anything less than 60 thousand cubic feet per day

Sunk Cost: Part of the capital costs actually incurred up to the date of reserves estimation minus depreciation and amortisation expenses. Items such as exploration costs, land acquisition costs and costs of financing can be included **(Page 201)**

Supervisory Control and Data Acquisition (SCADA): Software by which operators receive immediate detailed information about what is happening in the pipelines and monitor the levels of flow, pressure, temperature and density of the oil and gas **(Page 218)**

Surveys: Many different types of surveys are conducted in the oil and gas industry. These range from gravity surveys, magnetic surveys, electrical surveys, electromagnetic surveys, radiometric surveys, seismic surveys, radar surveys and downhole electrical and calliper surveys. Surveys are conducted for different purposes at regional scales (covering large areas, both on the ground and from aircraft) and at local scales (covering specific sites such as mineral prospects, again on the ground or with airborne instruments, or by using underground wellbores) **(Page 28)**

Synclines: Basin—or trough—shaped fold in rock in which rock layers are downwardly convex. The youngest rock layers form the core of the fold and outward from the core progressively older rocks occur. Synclines typically do not trap hydrocarbons because fluids tend to leak up the limbs of the fold **(Page 20)**

Synthetic Oil-Based Mud (SOBM): A type of drilling mud that is water insoluble and low in toxicity and thus will not significantly impact the marine environment nor contribute to environmental pollution **(Page 195)**

Tar Sands: Naturally occurring bitumen-impregnated sands that yield mixtures of liquid hydrocarbon and that require further processing other than mechanical blending before becoming finished petroleum products **(Page 25)**

Tension Leg Platforms (TLPs): A vertically moored floating structure normally used for the offshore production of oil or gas. It is particularly suited for water depths greater than 300 m (about 1,000 ft) **(Page 137)**

Thermal Cracking: A refining process in which heat and pressure are used to break down, rearrange, or combine hydrocarbon molecules. Thermal-cracking includes gas oil, visbreaking, fluid coking, delayed coking and other thermal cracking processes (e.g., flexicoking)

Thermal Efficiency: A measure of the efficiency of converting a fuel to energy and useful work; useful work and energy output divided by higher heating value of input fuel times 100 (for percent)

TLP: See **Tension Leg Platform**

Toluene ($C_6H_5CH_3$): Colourless liquid of the aromatic group of petroleum hydrocarbons, made by the catalytic reforming of petroleum naphthas containing methyl cyclohexane. A high-octane gasoline-blending agent, solvent, and chemical intermediate, and a base for TNT (explosives) **(Page 230)**

Training to Reduce Unscheduled Events (TRUE): Enrolling and focusing the drilling team is often achieved through 'Training to Reduce Unscheduled Events' and 'Drill the Well On Paper' exercises **(Page 185)**

Transgression: Occurs when sea levels rise to invade the continents **(Page 20)**

Transportation Sector: A major energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are: automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. **(Page 281)**

Traps: A configuration of rocks suitable for containing hydrocarbons and sealed by a relatively impermeable formation through which hydrocarbons will not migrate **(Page 24)**

TRUE: See **Training to Reduce Unscheduled Events (Page 185)**

Underbalanced Drilling: Drilling under conditions where the pressure being exerted inside the wellbore (from the drilling fluids) is less than the pressure of the oil or gas in the formation

Underground Injection: The placement of gases or fluids into an underground reservoir through a wellbore. May be used as part of EOR, waterflooding processes or for disposal of produced water

Under-reamer: Expandable downhole tool used to enlarge a wellbore below a restriction **(Page 175)**

Undersaturated Fluid: Liquid or vapour capable of holding additional gaseous or liquid components in solution at the specified pressure and temperature

Undiscovered Recoverable Reserves (Crude Oil and Natural Gas): Economic resources of crude oil and natural gas, yet undiscovered, that are estimated to exist in favourable geologic settings

Upstream: The E & P segments of the oil and gas industry including seismic, drilling and completions and production to the wellhead **(Page 85)**

Vacuum Distillation: Distillation under reduced pressure (less the atmospheric) which lowers the boiling temperature of the liquid being distilled. This technique with its relatively low temperatures prevents cracking or decomposition of the charge stock

Vanadium: A heavy metal impurity that reduces the value of the crude and makes it more expensive to refine **(Page 36)**

Viscosity: A measure of the resistance to flow exerted by fluids and the parameter is needed to estimate flow rates as functions of pressure drops. Gaseous viscosities at low pressures increase with temperature (the opposite is true for oils) and of the order 0.01-0.05 cp (water is around 0.3 to 1.0 cp at reservoir conditions). The low gas viscosities mean that, for a given pressure gradient, gas will flow some 10-100 times faster than oils. Gas viscosities are difficult to measure, particularly at reservoir conditions and correlations are usually used and give sufficient precision **(Page 57)**

Visualization Theatres: Theatres that project subsurface data in 3D so that it may be better understood

VIV: See **Vortex-Induced Vibration (Page 185)**

VOCs: See **Volatile Organic Compounds**

Volatile Organic Compounds (VOCs): Organic compounds that participate in atmospheric photochemical reactions

Vortex-Induced Vibration (VIV): Motions induced on bodies facing an external flow by periodical irregularities on this flow **(Page 185)**

Waste Oils and Tar: Petroleum-based materials that are worthless for any purpose other than fuel use

Waterflooding: Injection of water into an oil reservoir to 'push' additional oil out of the reservoir rock and into the wellbores of producing wells

Wax: Solid or semi-solid material at 77°F consisting of a mixture of hydrocarbons obtained or derived from petroleum fractions, or through a Fischer-Tropsch type process, in which the straight chained paraffin series predominates. This includes all marketable wax, whether crude or refined **(Page 189)**

Well: Hole drilled in the earth for the purpose of: finding or producing crude oil or natural gas; or, producing services related to the production of crude or natural gas **(Page 24)**

Wellhead: The point at which the crude (or natural gas and water) exit the ground. Following historical precedent, the volume and price for crude oil production are labelled as 'wellhead' even though the cost and volume are now generally measured at the lease boundary **(Page 57)**

Wellhead Price: The value at the mouth of the well. In general, the wellhead price is considered to be the sales price obtainable from a third party in an arm's length transaction. Posted prices, requested prices or prices as defined by lease agreements, contracts, or tax regulations should be used where applicable

Well Servicing: Maintenance or remedial work performed on an oil or gas well to improve or maintain production

West Texas Intermediate (WTI): A type of crude oil commonly used as a price benchmark as is Brent crude **(Page 238)**

Wet Barrels: Commercial trade of petroleum denoting the physical exchange of oil or gas as opposed to paper-based trade or speculation of derivatives or commodities that are not physically exchanged

Wet Gas: Natural gas containing significant amounts of liquefiable hydrocarbons **(Page 63)**

Wet Natural Gas: Mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in porous rock formations at reservoir conditions. The principal hydrocarbons normally contained in the mixture are methane, ethane, propane, butane and pentane. Typical non-hydrocarbon gases that may be present in natural gas reservoirs are water vapour, carbon dioxide, hydrogen sulphide, nitrogen and trace amounts of helium. Under reservoir conditions, natural gas and its associated liquefiable portions occur either in a single gaseous phase in the reservoir or in solution with crude oil and are not distinguishable at the time as separate substances. Note: The SEC and the Financial Accounting Standards Board refer to this product as natural gas.

Wildcat Well: Well drilled in an area where no current oil or gas production exists. Also called a 'Rank Wildcat' **(Page 136)**

Wind Power: Energy, created by using the natural movement of air in the atmosphere, to turn turbines that generate electricity **(Page 271)**

Wind Turbines: Machines that have a rotor used to produce electrical energy **(Page 271)**

Working Interest: An interest in a mineral property that entitles the owner of that interest to all shares of the mineral production from the property, usually subject to a royalty. A working interest permits the owner to explore, develop and operate the

property. The working-interest owner bears the costs of exploration, development and operation of the property and, in return, is entitled to a share of the mineral production from the property or to a share of the proceeds there from. It may be assigned to another party in whole or in part, or it may be divided into other special property interests

Workover: Operations on a producing well to restore or increase production. A workover may be performed to stimulate the well, remove sand or wax from the wellbore, to mechanically repair the well or for other reasons **(Page 127)**

WTI: See **West Texas Intermediate (Page 238)**

Zeolite: A catalytic substance commonly used to accelerate the cracking process **(Page 231)**