CRUDE OIL: SOURCE COMPANION

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companion to CRUDE OIL: Rock, Fuel, Empire

Every reference number [n] in the manuscript resolves here. Each entry records what the source is, how fully it was read, what it supports, and its limitations. Read levels: FULL (read end to end), EXCERPT (the cited passages read directly), HIGHLIGHTS (search-result extracts from the owning site). Sources read for background but not cited are listed separately at the end. Leads registered but never read are excluded entirely.

Numbered sources

[1]

EIA: US produced more crude oil than any country in 2025 | 2026-07-09 | FULL | US crude incl condensate 13.6 mb/d avg 2025 (record; 2024 13.2); US #1 since 2018 overtaking Russia; US ~40% above Russia and Saudi combined; Russia 9.9 mb/d 2024, ~unchanged 2025 (cuts + Ukraine-conflict effects); Saudi 9.2->9.6 mb/d 2025 on OPEC+ unwinding; WTI avg $77/b 2024 -> $65/b 2025 amid oversupply; Permian 6.3->6.6 mb/d ~48% of US; shale reversed multi-decade US decline from 2008 | EIA series; crude+condensate basis

Source: eia.gov/TODAYINENERGY/detail.php?id=67844

[2]

EIA: Low liquidity and limited storage pushed WTI below zero | 2020-04-27 | FULL | Apr 20 2020 WTI front-month to -$40.32/b ~2:30pm ET, first negative since 1983 listing; ~1% of futures physically delivered; Cushing working capacity 76m bbl, stocks 60m (58m tank farms, 76% full); refinery runs 12.8 mb/d (-4.1 mb/d, -24% YoY); Brent June settled +$19.33 Apr 21; negativity mostly confined to expiring contract | Dated explainer; settlement -$37.63 is the CFTC figure

Source: eia.gov/Todayinenergy/detail.php?id=43495

[3]

EIA Energy Explained: oil and petroleum products | undated | FULL | Mixtures of hydrocarbons from marine organisms (diatoms) that lived millions of years ago before dinosaurs; burial, heat, pressure; "petroleum" = rock oil; reservoirs in sedimentary pore spaces; 42-gal barrel yields ~45 gal products (processing gain, popcorn analogy) | Public explainer

Source: eia.gov/energyexplained/oil-and-petroleum-products/

[4]

EIA Energy Explained: refining crude oil | undated | FULL | US avg per 42-gal barrel: 19-20 gal gasoline, 11-13 gal distillate (mostly diesel), 3-5 gal jet; >12 other products; refineries run 24/7, large sites | US-average yields

Source: eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil.php

[5]

2026-11-01 | FULL | News reporting at time of writing: December targets to hold steady, "agreed in principle" via unnamed sources; rollback of 1.65 mb/d (2023 tranche) completed Sept 2026; ~2 mb/d layer through end-2026; capacity review Q4 2026 for 2027 baselines; Gulf exports disrupted by "Iran war" | December 2026 outcome still pending at time of writing

Source: thehindubusinessline.com (Reuters/ANI) OPEC+ Dec 2026 targets unchanged

[6]

read 2026-11-01 | FULL | 2021 multi-source comparison (BP/Eni/OPEC/CIA/EIA): Venezuela ~303.8 bn; Saudi 258.5-297.5; Iran 157.8-208.6; Canada 168.1 (BP, incl oil sands) vs ~5 (OPEC, excl); Canada jump 2003; Venezuela jump late 2000s; R/P spread: Venezuela 858y, Saudi 77, US 9-10; notes inconsistent shale/tar-sand treatment | Compilation; prefer primary for final numbers

Source: en.wikipedia.org/wiki/List_of_countries_by_proven_oil_reserves

[7]

OPEC Annual Statistical Bulletin 2024 | 2024 | EXCERPT | World proven crude reserves 1,570 bn bbl end-2023 (+0.4% YoY); OPEC members 1,241.331 bn (~79%); member table values (Saudi 267,230 mb etc.) | Member-reported; excludes Canada oil sands from "crude"

Source: opec.org asb-2024.pdf

[8]

Drake Well Museum | undated | FULL | Drake agent of Seneca Oil Co (Connecticut), arrived Titusville 1857; adapted salt-well drilling with William "Uncle Billy" Smith; Aug 27 1859 struck oil at 69.5 ft; mission: crude for kerosene refining | Museum site history

Source: drakewell.org/about-us/site-history

[9]

TSHA: Spindletop Oilfield | undated | FULL | Jan 10 1901 Lucas gusher at 1,139 ft; ~100,000 b/d, capped Jan 19 after 9 days; salt-dome; Gladys City Co (1892); Higgins/Lucas/Guffey&Galey/Mellon; Hamill brothers rotary rig; land $150->$20,000->$50,000 in 15 min; Beaumont 10k->50k people; 17.5m bbl 1902, down to 10,000 b/d Feb 1904; ~$235m invested in Texas oil that year | Scholarly state encyclopedia

Source: tshaonline.org/handbook/entries/spindletop-oilfield

[10]

ASME | undated | FULL | Salt-well + modern pipe-driving methods; pre-Drake seep skimming 18 gal/day; struck 69 ft (their figure) Aug 27 1859; averaged 1,000 gal/day for 3 years; first export 1866; "Drake brought in by investors in 1853" | CONFLICT: museum says Drake arrived 1857; keep both framings or use museum for arrival date

Source: asme.org Drake Oil Well landmark

[11]

AOGHS: Camphene to Kerosene Lamps | 2026-03-19 | FULL | Lamp fuels pre-1859: whale oil $1.30-2.50/gal, lard oil ~$0.90, camphene (turpentine spirits) + alcohol burning fluids (flash fires); ~250 lamp patents by 1850; Gesner patented kerosene 1854, named it; Long Island factory; Baltimore first gas street lamp 1817; Philadelphia Gas Works piped gas to 46 street lamps 1836; Porter patented his camphene mixture 1835 (1:4 turpentine:alcohol + camphor), Boston; 'camphene' coined in Webb's 1838 patent; distilleries sent >=90m gal/yr alcohol to lighting by 1860; kerosene ~50c/gal from "tea-kettle" stills 40-4,000 gal/day; Internal Revenue Act $2.08/gal alcohol tax 1862-64 killed camphene; "whale oil myth" - tax asymmetry, not whales, was kerosene's edge | Trade-history society; whale-myth framing corroborated by Lienhard (see [23])

Source: aoghs.org/products/camphene-to-kerosene-lamps/

[12]

Ohio State Mershon Center | undated | FULL (short page) | Russia abolished state oil monopoly in 1870s; Nobel brothers (Ludwig, Robert) dominant refiners; BNITO (Caspian & Black Sea Petroleum Co) built Caspian-Black Sea railroad financed by French Rothschilds; Rothschilds bought BNITO 1886; holdings transferred to Royal Dutch Shell 1912; spur to Standard Oil multinational + Shell transport | Project abstract level

Source: mershoncenter.osu.edu Baku/Rothschilds project page

[13]

read 2026-11-01 | FULL | API = 141.5/SG - 131.5; >10 floats on water; most liquids 10-70 deg; WTI 39.6 deg ~7.6 bbl/tonne; 1916 NBS Baume adoption; 1921 API scale fix (modulus 141.5 vs 140) | Reference article

Source: en.wikipedia.org/wiki/API_gravity

[14]

AAPG Explorer: Ghawar | 2005-01-01 | FULL | Ghawar discovered 1948; 174 mi x 16 mi, 1.3m acres; ~55 bn bbl cumulative by mid-2000s; ~5 mb/d avg over prior 10 yrs; >half of Saudi output; Arab-D Jurassic limestone reservoir ~280 ft thick at 6,000-7,000 ft; Hanifa source; anhydrite seal; Steineke structural drilling; Berg plane-table Haradh 1949; joined as single field 1955; Afifi "five conditions" | Dated (2005); production figures as-of then

Source: aapg.org/news-and-media/explorer/the-elephant-of-all-elephants/

[15]

EIA STEO Global oil markets | released 2026-10-06 | FULL | Brent avg $114/b Sept 2026 (+$23 vs Aug); attacks on Middle East oil infrastructure and tankers; Saudi East-West pipeline (>5.0 mb/d to Yanbu) temporarily halted, daily Brent $131 Sept 15, partially resumed Sept 22; shut-ins 10.9 mb/d May peak -> 5.8 Aug -> 4.8 Sept, assume ~4.5 Q4-26, pre-conflict by end-2Q27; Brent forecast $105 Q4-26, $87 2Q27, $74 4Q27; inventories -1.9 mb/d 3Q26, -0.7 4Q26; record tanker rates; Table (million b/d): production 103.2 (2024), 106.3 (2025), 101.1 (2026p), 109.6 (2027p); OPEC 28.4/29.3/23.9/29.2; non-OPEC 74.7/77.0/77.2/80.4; consumption 103.1/104.4/102.4/104.6; Brent $81/69/96/84 | "Liquid fuels" broad measure, NOT crude-only; forecast dated Oct 6 2026; EIA says "attacks", war framing belongs to news sources

Source: eia.gov/outlooks/steo/report/global_oil.php

[16]

OPEC Brief History | read 2026-11-01 | FULL | Baghdad Conference Sept 10-14 1960: Iran, Iraq, Kuwait, Saudi Arabia, Venezuela; then Qatar 1961 (left Jan 2019), Indonesia 1962 (suspended 2009, back Jan-Nov 2016), Libya 1962, UAE 1967, Algeria 1969, Nigeria 1971, Ecuador 1973 (out 1992, back 2007, withdrew 1 Jan 2020), Angola 2007 (withdrew 1 Jan 2024), Gabon 1975 (out 1995, back 2016), Eq. Guinea 2017, Congo 2018; Geneva HQ first 5 yrs, Vienna from Sept 1 1965; 1968 Declaratory Statement permanent sovereignty; founding context: market dominated by Seven Sisters; objectives text | Official history; still lists UAE as member (see 18)

Source: opec.org/brief-history.html

[17]

WAM: UAE announces decision to exit OPEC & OPEC+ | 2026-04-28 | FULL | "The United Arab Emirates today announced its decision to exit the Organisation of the Petroleum Exporting Countries (OPEC and OPEC+), effective 1 May 2026... long-term strategic and economic vision and evolving energy profile, including accelerated investment in domestic energy production"; UAE joined 1967 via Abu Dhabi, continued post-1971 union; will bring additional production gradually | UAE state agency (owning source for its own decision)

Source: wam.ae/en/article/bzxzuh7-uae-announces-decision-exit-opec-opec+

[18]

OPEC Member Countries | read 2026-11-01 | FULL | Static page still says "currently, the Organization has a total of 12 Member Countries" and lists UAE (1967) with no withdrawal; records Ecuador/Qatar/Angola exits only | STALE vs 17/19: keep conflict visible; book says 11 members since May 1 2026, noting page lag

Source: opec.org/member-countries.html

[19]

OPEC press release, Oct 4 2026 | 2026-10-04 | FULL | Seven countries (Saudi Arabia, Russia, Iraq, Kuwait, Kazakhstan, Algeria, Oman - no UAE) maintain Sept 2026 required production for November; monthly meetings; next meeting Nov 1 2026 | Official; Dec outcome (5) remains news-only

Source: opec.org/pr-detail/616-4-october-2026.html

[20]

read 2026-11-01 | FULL | Element range by weight: C 83-85%, H 10-14%, N 0.1-2%, O 0.05-1.5%, S 0.05-6%, metals <0.1%; hydrocarbon types avg: paraffins 30% (15-60), naphthenes 49% (30-60), aromatics 15% (3-30), asphaltics 6%; alkanes C5-C8 gasoline, C9-C16 diesel/kerosene/jet, >C16 fuel oil/lubes; wax ~C25, asphalt C35+; gas cap/oil/saline water layering; kerogen types I algal, II plankton, III humic; catagenesis 60-several hundred C over thousands-millions of years; geothermal gradient 10-30 C/km; oil window: below = kerogen, above = gas (thermal cracking); Athabasca shallow-migrated; Canada+Venezuela ~3.6 tn bbl bitumen/extra-heavy in place ~2x conventional reserves estimate; condensate definition; live bacteria in reservoirs | Reference article; in-place vs reserves distinction kept

Source: en.wikipedia.org/wiki/Petroleum

[21]

read 2026-11-01 | FULL | Herodotus: asphalt in Babylon walls/towers, Zacynthus pitch spring, Ardericca bitumen well; China: raw oil use by 1st c BC, fuel by 4th c BC, gas wells AD 347 up to ~240 m via bamboo bits for brine salt, 10th-c bamboo pipelines; Shen Kuo coined shiyou "rock oil" 1088; Baghdad tar-paved streets; Baku fields by 9th c (al-Masudi 10th c; Marco Polo 13th c "hundreds of shiploads"); distillation via Islamic Spain by 12th c; Romania păcură 13th c; "petroleum" from southern Italian monasteries by end of 1st millennium; Raleigh Trinidad Pitch Lake 1595; US + Russia 97% of 19th-c world output; Gesner kerosene from coal/bitumen/oil shale; James Young 1847 seep distillation lamp+lubricating oils | Reference article; some claims single-sourced to it - verify before superlatives

[22]

Visualizing Energy (Cutler Cleveland) | 2023-01-23 | FULL | SPE proved-reserves definition (verbatim, 1997); ~90% of reserves held by state-owned enterprises (author's estimate, "notoriously secretive"); SEC disclosure regime for listed companies; OPEC 1983 quota-rule change -> "quota fight" reserve inflation; Canada reserves x7 1997-2008 (oil sands), Venezuela x3 2007-2011 (Orinoco heavy); OPEC excludes Canada oil sands but includes Venezuelan heavy oil; Saudi/Kuwait/UAE constant-reserves anomaly not observed where justification required; "unburnable carbon" framing | Analytical/academic project; attribute as this source's analysis, not consensus census

Source: visualizingenergy.org/why-do-oil-reserve-estimates-vary-so-widely/

[23]

John Lienhard, UH: The Whale Oil Myth | 2020 | FULL | Whale oil pricey and elite by Civil War; most lamps burned coal oils, turpentine, lard, alcohol, camphene; kerosene arrived just before Civil War; wartime tax 10c/gal kerosene vs up to $2/gal on camphene's alcohol - petroleum's decisive edge was tax asymmetry over camphene, not whales; petroleum lighting a stopgap until Edison's electric lighting 1882 | Named-scholar interpretation; present attributed, alongside Davis/Gallman/Gleiter fleet-collapse account (see [24])

Source: egr.uh.edu/parameters/2020-spring/whale-oil-myth

[24]

Derek Thompson, The Atlantic | 2012-02-22 | read 2026-11-01 | FULL | Summarises Davis, Gallman & Gleiter (In Pursuit of Leviathan): US whaling fleet fell 90% within 50 yrs of 1846 peak (640 ships, 5th largest US industry); decline driven by US wages +1/3 in 1860s-80s (3x Norwegian seaman), opportunity cost of capital, capital migrating to railroads/oil/steel; Norway took global share; petroleum's rise was contemporaneous, not the cause of the fleet's fall | Secondary journalism summarising named economic historians; the fleet-collapse account paired with [23]

Source: theatlantic.com/business/archive/2012/02/the-spectacular-rise-and-fall-of-us-whaling-an-innovation-story/253355/

[25]

AAPG Explorer: The Bibi-Heybat Oil Field (Mir-Yusif Mir-Babayev) | 2021-08-01 | FULL | 1846 Bibi-Heybat well "laid the foundation" (author's framing: world's first drilled oil well); Absheron "Land of Fire"; Cyrus II's army used oil as incendiary 6th c BC; Alexander's soldiers used Absheron oil for lighting (Plutarch); fire temples Surakhani; by 1899 Azerbaijan led world production, ~half of world oil that year; 1899-1901 Russia/Baku 84.3m bbl/yr vs US 66.7m | Author advocates the Baku priority claim; national framing noted; 1899-1901 production figures useful but single-source

Source: aapg.org/news-and-media/explorer/the-bibi-heybat-oil-field/

[26]

Ernest C. Miller, "North America's First Oil Well - Who Drilled It?", Western Pennsylvania Historical Magazine 42(4) | 1959-12 | FULL | Williams' 1858/1859 drilling "not documented and they have not been to this day"; Williams dug well nearly as deep as Drake's, produced, refined, marketed (first Canadian producer); Oil Springs 1958 centennial officials used 1858 as "more conclusive evidence"; WV 1825 sand pits, Pico hand-dug wells California (dug wells ruled out of "drilled" claims by definition) | Period piece (1959) by industry historian; the careful adjudication

Source: journals.psu.edu/wph/article/viewFile/2664/2497

[27]

Branobel History (Brita Åsbrink): Ludvig Nobel builds the world's first modern tanker | 2011-08-15 | FULL | Zoroaster ordered Nov 1877 at Lindholmen/Motala works, Bessemer steel, first steel tanker built for oil with eight built-in (removable) cisterns; sailed Baltic->Volga->Baku May 1878; sized to Don/Volga drafts; oil in oak casks exploded often; Buddha & Nordenskiöld shipped in parts, assembled Astrakhan; six more tankers 1881-82; Petrolea 1886 first ocean-going; Zarathustra company symbol | Company-history site; "first modern tanker" claim = their framing (note s/s Vaderland 1872 steel but repurposed)

Source: branobelhistory.com/distribution/ludvig-nobel-builds-the-worlds-first-modern-tanker/

[28]

EIA: US produced more crude than any nation at any time (6 yrs running) | 2024 | FULL | US crude+condensate: 1970 peak 9.6 mb/d; decline to 5.0 in 2008; growth from 2009 on hydraulic fracturing + horizontal drilling; 2019 record 12.3; 2023 record 12.9 avg; Dec 2023 monthly >13.3; Russia peaked 2019 at 10.8; Saudi peaked 2022 at 10.6, Aramco stated capacity 12.0 + ~0.3 Neutral Zone | EIA series

Source: eia.gov/TodayinEnergy/detail.php?id=64125

[29]

FACETS: A critique of Hubbert's model for peak oil | 2018-03-08 | FULL | Hubbert 1956 API paper: logistic model; US lower-48 peak 1970 predicted correctly; world: Q-inf 1,250 Gbbl, peak rate 2.5x 1956 (12.5 Gbbl/yr) -> peak "about the year 2000" (wrong); core assumption: "progressive exhaustion of an initially fixed supply to which there will be no significant additions"; data: reserves +~29-30 Gbbl/yr since 1980 (r=0.9895), world production ~tripled since 1964; Alaska late-70s bump, fracking post-2008 break the symmetry | Peer-reviewed critique

Source: facetsjournal.com/doi/10.1139/facets-2017-0097

[30]

read 2026-11-01 | FULL | Mintrop mechanical seismograph 1914, Seismos founded 1921, first commercial refraction discovery Orchard salt dome Texas 1924, Gulf Coast refraction boom exhausted shallow domes by 1930; Geological Engineering Co 1920; first exploration reflection seismograph June 1921 near Oklahoma City (Karcher, Haseman, Perrine, Kite); GRC 1925 (Amerada); GSI 1930 (Karcher) -> parent of Texas Instruments; Western Geophysical 1933 (Salvatori); 3D experiments 1960s, first large 3D late 1970s, widespread 1980s-90s; wide-azimuth Mad Dog 2004; ocean-bottom nodes Atlantis 2005, first 4D nodes 2009; interpretation admits multiple solutions, interpreters "encouraged to be optimistic" | Reference article

Source: en.wikipedia.org/wiki/Reflection_seismology

[31]

read 2026-11-01 | EXCERPT (history sections) | Founded 1926 Paris as Societe de prospection electrique by Conrad & Marcel Schlumberger; first electrical resistivity well log Merkwiller-Pechelbronn 1927; first US log Kern County 1929; Houston 1934; SARABAND first computerized reservoir analysis 1970; NYSE 1962 | Reference article

Source: en.wikipedia.org/wiki/Schlumberger

[32]

read 2026-11-01 | FULL | Primary ~10% OOIP; secondary (water/gas injection) 20-40%; EOR target 30-60%+; four families: CO2 (most common; patented 1952, first commercial Scurry County TX 1977), other gas, thermal (steam, commercial California 1960s), chemical (polymer/surfactant); 374 projects 2017: 44% CO2, 32% thermal, 12% other gas, 9% chemical | Reference article

Source: en.wikipedia.org/wiki/Enhanced_oil_recovery

[33]

read 2026-11-01 | FULL | 1891 submerged wells on piles, Grand Lake St. Marys Ohio; 1946 Magnolia platform 18 mi off Louisiana in 18 ft; early 1947 Superior 20 ft off Vermilion; Oct 1947 Kerr-McGee Ship Shoal Block 32 = first discovery out of

sight of land; jack-ups for 100-390 ft | Reference article

Source: en.wikipedia.org/wiki/Offshore_drilling

[34]

read 2026-11-01 | FULL | Farris/Stanolind 1947 Hugoton experiment (1,000 gal gelled gasoline + Arkansas River sand, 2,400 ft); J.B. Clark 1948 paper; 1949 patent, Halliburton exclusive license, first 2 commercial treatments 17 Mar 1949 Stephens Co OK + Archer Co TX; ~1M wells treated since (their figure, dated); massive frac Pan American 1968; horizontal wells Austin Chalk late 1980s; Steinsberger/Mitchell Energy slickwater Barnett 1997, S.H. Griffin No.3 1998; first Barnett horizontal 1991; laterals 1,500-5,000 ft Barnett, up to 10,000 ft Bakken; yields typically fall after first year or two; permeability microdarcy-nanodarcy; 2.5M frac jobs worldwide by 2012 | Reference article

Source: en.wikipedia.org/wiki/Fracking

[35]

read 2026-11-01 | EXCERPT | Han dynasty percussion drilling; 16th-c Chinese wells >2,000 ft; Chinese technique to Europe 1828; Drake modernized with steam engines; walking ADR rigs ~$25M each, first SAGD slant ADR June 2005 (Ensign/Deer Creek) | Reference article

Source: en.wikipedia.org/wiki/Drilling_rig

[36]

read 2026-11-01 | FULL (history) | McAfee 1915 AlCl3 batch (too costly); Houdry/Prudhomme 1922 lignite lab; Fuller's earth catalyst; 1936 Paulsboro 2,000 b/d demo; 1937 Sun Oil Marcus Hook 12,000 b/d, ~50% gasoline vs ~25% thermal; 1940: 14 Houdry units 140,000 b/d; TCC 1943 Beaumont; 300,000 b/d by 1945; Model I FCC Baton Rouge May 25 1942, 13,000 b/d (Campbell/Martin/Murphree/Tyson, Standard Oil of NJ; Kellogg-built); high-octane avgas WW2 claim ('it is said'); FCC regenerator heat-balance; 5 kg catalyst per kg feed | Reference article

Source: en.wikipedia.org/wiki/Fluid_catalytic_cracking

[37]

read 2026-11-01 | EXCERPT | 2020 world capacity ~101.2 mb/d; Jamnagar largest since Dec 2008, 1.24 mb/d; Abadan largest for most of 20th c.; Ploiesti first large refinery 1856-57; Edeleanu process 1908; pre-WW2 US refineries mostly distillation + visbreakers; US: 301 refineries 1982 -> 132 by 2025, capacity 17.9->18.4 mb/d; no new US refinery 1976-2014 | Reference article

Source: en.wikipedia.org/wiki/Oil_refinery

[38]

read 2026-11-01 | EXCERPT | Midgley/GM discovered antiknock effect 9 Dec 1921 after ~33,000 substances screened; 1:1300 by weight sufficient; US phase-out from 1970s, on-road sales ended 1 Jan 1996; worldwide end July 2021 (Algeria), UNEP 'official end' 30 Aug 2021; est. 15M tonnes lead emitted globally; still used in avgas | Reference article

Source: en.wikipedia.org/wiki/Tetraethyllead

[39]

read 2026-11-01 | EXCERPT | Shukhov thermal cracking patent 1891 (Russia, no.12926); Burton 1912 process 370-400C; Burton-Humphreys US patent 1908; Dubbs process 1921, used until early 1940s; Sinclair 1924 visit to Shukhov re patent challenge | Reference article

Source: en.wikipedia.org/wiki/Cracking_(chemistry)

[40]

read 2026-11-01 | EXCERPT | Largest share of products = fuels (gasoline, jet, diesel, heating oil, fuel oil); heavier fractions -> asphalt, tar, wax, lubricants; byproducts sulphur, petroleum coke, hydrogen; blending w/ additives (dyes, detergents, oxygenates) | Reference article

Source: en.wikipedia.org/wiki/Petroleum_product

[41]

read 2026-11-01 | EXCERPT | Olefins (ethylene/propylene) + aromatics (BTX) the two classes; ethylene 190 Mt, propylene 120 Mt, aromatics ~70 Mt (2019); growth in Middle East/Asia; history: Regnault PVC 1835, Perkin mauveine 1856, Baekeland bakelite 1909, Union Carbide first petchem plant 1920, Buna-S 1929, polyethylene Perrin 1935, nylon Carothers 1937, polyurethane 1938, Teflon 1941, polyester 1946, PP early 1950s, Kevlar 1965 | Reference article

Source: en.wikipedia.org/wiki/Petrochemical

[42]

read 2026-11-01 | EXCERPT | First crude pipeline: Oil Transport Assoc., 2-inch wrought iron, 6 mi, Pennsylvania oil field to Oil Creek rail station, 1860s; Operation Pluto 1944 Channel pipelines, ~8% of Allied Western Front petroleum | Reference article

Source: en.wikipedia.org/wiki/Pipeline_transport

[43]

read 2026-11-01 | EXCERPT | Modern tanker developed 1877-1885; Nobel Branobel; T2 16,500 DWT/162 m; 1956 Suez closure -> Cape route -> size race; Seawise Giant 1979, 564,763 DWT, 458.45 m, couldn't transit English Channel laden; scrapped as Mont 2009; TI class 441,500 DWT, 3.17M bbl, first double-hull ULCCs (2002-03) | Reference article

Source: en.wikipedia.org/wiki/Oil_tanker

[44]

read 2026-11-01 | EXCERPT | EPCA Dec 22 1975 after 1973-74 embargo; first oil 21 Jul 1977 (Saudi light); salt caverns TX/LA, capacity 714M bbl; max drawdown 2.7 mb/d, oil to market 13 days after order; 2015+ Congress mandated sales (132M bbl by ~2023); 2022 Biden 1 mb/d 180 days at avg $96, largest ever, 40-yr low; Mar 2026: 172M bbl release over 120 days announced (Chris Wright), part of IEA 32-nation 400M bbl; June 2026 lowest since 1983 amid Iran-war deployments; inventory 285.4M bbl on 4 Sep 2026 | Reference article; 2026 SPR figures primary-verified 2026-11-01 against the energy.gov statement of 11 Mar 2026 (IEA 32-nation 400M bbl coordinated release; US 172M bbl over ~120 days) and the EIA weekly SPR series (285,360k bbl on 4 Sep 2026; 283.0M on 2 Oct 2026)

Source: en.wikipedia.org/wiki/Strategic_Petroleum_Reserve_(United_States)

[45]

read 2026-11-01 | EXCERPT | 2023-25: 25% of seaborne oil trade, 20% of LNG; 2018: 21 mb/d; ~18-19 mb/d ~ 20% of global consumption (2025 analysts); 2026 conflict: insurance 0.125% -> 0.2-0.4% then 4-6x, tanker traffic collapsed >90% (~10 mb/d restricted), ~12 mines reported, 3 vessels hit Mar 12, the day after the IEA 400M bbl release was announced 11 Mar (IEA news, 11 Mar 2026); onshore bypass pipelines ~3 mb/d max | Reference article; key 2026 figures primary-verified against IEA Oil Market Report, 12 Mar 2026 (largest supply disruption in the history of the global oil market; Hormuz flows ~20 mb/d reduced to a trickle; Gulf cuts >=10 mb/d) and Reuters, 12 Mar 2026

Source: en.wikipedia.org/wiki/Strait_of_Hormuz

[46]

read 2026-11-01 | FULL | Standard Oil founded 1870 Cleveland; railroad rebates/kickbacks; trust consolidation; Tarbell 1904 History; DOJ suit 1906, ~12,000-page report; circuit court dissolution 1909; SCOTUS 1911 unanimous, 'rule of reason' (White CJ), dissolved into 34 companies | Owning secondary (Supreme Court Historical Society)

Source: civics.supremecourthistory.org/article/standard-oil-company-v-united-states/

[47]

read 2026-11-01 | FULL | 1933 concession to Standard Oil of California; GBP 50,000 loan + royalties, tax-free; Dammam No.7 1938 first commercial oil; 50-50 profit share 1950; 1973-80 staged Saudi takeover; 1988 royal decree = Saudi Aramco; 1981 oil revenues $116bn | Owning secondary (PBS Frontline)

Source: pbs.org/wgbh/pages/frontline/shows/saudi/etc/cron.html

[48]

read 2026-11-01 | EXCERPT | 'Super-Major' coined Feb 1998 Morgan Stanley (Douglas Terreson); Seven Sisters coined by Enrico Mattei; Sisters = Consortium for Iran cartel, dominated mid-1940s-1970s: APOC(BP), Shell, Socal+Gulf+Texaco(Chevron), Jersey+Socony(ExxonMobil) | Reference article

Source: en.wikipedia.org/wiki/Big_Oil

[49]

read 2026-11-01 | FULL | 1901 D'Arcy concession: 60 yrs, most of Persia, GBP 20,000 + shares + 16% of profits; Reynolds; May 1908 abandon order delayed, oil struck 26 May 1908 Masjed Soleyman; APOC founded 1909; Abadan refinery 1913 (world's largest ~50 yrs); 1914 UK govt 51% via Churchill/Admiralty navy oil-fuel conversion, 20-yr supply contract; 1931 royalties GBP 366,782 vs GBP ~1,000,000 UK income tax; Nov 1932 Reza Shah cancelled D'Arcy concession; renamed AIOC 1935;

nationalised 1951 (Mossadegh; see Part X) | Reference article

Source: en.wikipedia.org/wiki/Anglo-Persian_Oil_Company

[50]

read 2026-11-01 | EXCERPT | Founded 1966 Rotterdam (Henk Vietor); HQ Geneva/Rotterdam; >7.3 mb/d oil+products handled (~Japan's consumption); >350 Mt crude/yr, 250 vessels; revenue $343bn (2025); 2023 net profit ~$13bn per FT; world's largest independent energy trader | Reference article

Source: en.wikipedia.org/wiki/Vitol

[51]

read 2026-11-01 | FULL | Oct 19 1973 OAPEC embargo after Nixon $2.2bn Israel aid; price $2.90 -> $11.65 Jan 1974; lifted March 1974, prices stayed; Burns quote re cost pressures; dollar devaluation/Bretton Woods factor | Owning secondary (Fed History)

Source: federalreservehistory.org/essays/oil-shock-of-1973-74

[52]

read 2026-11-01 | FULL | Embargo extended to Netherlands, Portugal, South Africa; Kissinger parallel negotiations; lifted March 1974; consequences: SPR, 55 mph, CAFE, IEA creation | Owning secondary (State Dept historian)

Source: history.state.gov/milestones/1969-1976/oil-embargo

[53]

read 2026-11-01 | EXCERPT | Peak 1980 >$35; 1986 fall $27 to <$10, as low as $7; demand -13% 1979-81 US/EU/Japan; OPEC share <1/3 by 1985 from ~half in 1970s; Saudi output 10 mb/d 1981 -> 3.5 mb/d 1985; Sept 1985 Saudis quit swing role, netbacks, punish quota cheats | Reference article

Source: en.wikipedia.org/wiki/1980s_oil_glut

[54]

read 2026-11-01 | EXCERPT | 6 Mar 2020 Russia rejects cuts; 8 Mar Saudi discounts, Brent -30% (largest since Gulf War); Saudi to 12.3 mb/d; 9-10 Apr OPEC+ cut 9.7/10 mb/d agreed; 20 Apr 2020 WTI May contract -$37/bbl (first negative ever), Cushing working capacity ~76M bbl, 81% full by 24 Apr; 104 tankers to US shores; 2014-16: $114 -> $27 shale crash; OPEC+ formed Sept 2016 | Reference article

Source: en.wikipedia.org/wiki/2020_Russia-Saudi_Arabia_oil_price_war

[55]

read 2026-11-01 | EXCERPT | WTI = light sweet grade, 37-42 API, <0.42% S, deliverable Cushing OK; NYMEX futures; decontrol 28 Jan 1981 began spot market; benchmarks: Brent, Dubai/Oman, Urals, OPEC basket; Platts/Argus assessments | Reference article

Source: en.wikipedia.org/wiki/West_Texas_Intermediate

[56]

read 2026-11-01 | EXCERPT | Record $147.02/bbl 11 July 2008; June 27 2008 $141.71; fell below $100 late summer 2008, <$60 by Nov 6; bottom ~$32 (2008); >$100 in 2011-2013; <$50 late 2014 | Reference article

Source: en.wikipedia.org/wiki/World_oil_market_chronology_from_2003

[57]

read 2026-11-01 | EXCERPT | Iran nationalised AIOC March 1951 (Majlis, Mossadegh); British naval blockade of Abadan; UK sanctions 22 Aug 1951 (sugar/steel embargo, personnel withdrawal, blocked sterling accounts); US/Sweden/Belgium/Netherlands/Pakistan/W.Germany refused technicians, only Italy agreed; 1951-54 crisis; 1953 coup (Ajax) overthrew Mossadegh; 1954 Consortium for Iran formed (Seven Sisters, [48]) | Reference article

Source: en.wikipedia.org/wiki/Abadan_Crisis

[58]

read 2026-11-01 | EXCERPT | 29 Oct-7 Nov 1956 UK/France/Israel invasion after Nasser nationalised canal; canal closed Oct 1956-Mar 1957; pre-crisis: W.Europe imported 2 mb/d via Middle East - 1.2 mb/d by canal, 0.8 mb/d by Tapline/Kirkuk-Baniyas

pipelines; UK 44% canal shares bought 1875 GBP 4M | Reference article

Source: en.wikipedia.org/wiki/Suez_Crisis

[59]

read 2026-11-01 | EXCERPT | 20 Apr 2010 blowout, Macondo, 1,600 m water; 11 killed, 17 injured; 4.9M bbl +/-10%, largest marine spill; sealed 19 Sep 2010; govt report blamed cementing, BP main responsibility; 2012 guilty plea $4.525bn; 2016 $20.8bn settlement (largest US environmental); >$65bn total by 2018 | Reference article

Source: en.wikipedia.org/wiki/Deepwater_Horizon_oil_spill

[60]

read 2026-11-01 | EXCERPT | 24 Mar 1989 Bligh Reef, Prince William Sound; ~10.8M US gal (~260,000 bbl) spilled of 53.1M gal cargo; 1,300 mi coastline affected; NTSB: unsupervised master, unrested crew; second-largest US spill | Reference article

Source: en.wikipedia.org/wiki/Exxon_Valdez_oil_spill

[61]

read 2026-11-01 | EXCERPT | Cumulative 1870-2022: coal 32%, oil 24%, gas 10% of emissions; fossil+industry 1773 GtCO2; fossil CO2 37.4 GtCO2-eq 2023; warming ~1.2C at 2023, +0.18C/decade since 1981; CO2 ~50% above pre-industrial (2021); transport ~15% of GHG 2024; CO2 persists 150-1000 yrs | Reference article

Source: en.wikipedia.org/wiki/Greenhouse_gas_emissions

[62]

read 2026-11-01 | FULL | IEA Oil 2025 (mid-2025, pre-2026-war baseline): demand +2.5 mb/d 2024-30, plateau ~105.5 mb/d by 2030, small decline 2030; EVs 17M sold 2024, >20M 2025 (~1/4 of sales), displace 5.4 mb/d by 2030; petchems dominant growth from 2026, 18.4 mb/d by 2030 (1 in 6 barrels); combustible-fuel oil demand may peak 2027; India +1 mb/d largest growth; OECD -1.7 mb/d; capacity 114.7 mb/d by 2030; US = 90% of supply growth 2015-24, China = 60% of demand growth | Owning source (IEA)

Source: iea.org/reports/oil-2025/executive-summary

[63]

read 2026-11-01 via search highlights | EXCERPT | OPEC WOO 2025 (July 2025): demand 103.7 mb/d 2024 -> 113.3 mb/d 2030 -> ~123 mb/d 2050, 'no peak oil demand on the horizon' (al-Ghais foreword); non-OECD +28 mb/d to 2050, OECD -8.5; India +8.2, China +1.8; primary energy +23% to 2050 | Owning source (OPEC)

Source: opec.org/assets/assetdb/woo-2025.pdf

[64]

OPEC Annual Statistical Bulletin 2024: world refinery capacity and throughput table | 2024 | EXCERPT | World refining capacity 102.9 mb/d 2023 (+1.5 mb/d YoY, nearly all growth outside OECD, Middle East and Asia); US 17.9, China 16.81, India 4.84, South Korea 3.5, Japan 3.2, Saudi Arabia 3.3; world throughput 85.6 mb/d; US 16.5, China 14.8, India 5.2 | Refining table figures verified against the ASB archive table 2026-11-01

Source: publications.opec.org/asb/archive/chapter/123/2119/2125

[65]

read 2026-11-01 | EXCERPT (monopoly/antitrust sections) | Standard Oil: ~90% of US refining capacity 1880; 91% of refinement and 85% of final sales 1904; 'market share' (metric as stated in source, not further specified) ~70% by 1906 (year federal suit filed), ~64% by 1911; at least 147 refining competitors incl. Gulf, Texaco, Shell; 1911 regional production shares: 44% midcontinent, 29% California, 10% Gulf Coast; SCOTUS 1911 dissolution; company counts vary by source (34 new companies per [46]'s Fed History; 39 independent companies per this article) | Reference article; figures cited there to Hidy & Hidy and other standard histories; series mixes metrics (capacity, refining, sales, 'market share') - quoted as stated, not one consistent series

Source: en.wikipedia.org/wiki/Standard_Oil

[66]

read 2026-11-01 | EXCERPT | Marc Rich + Co AG founded 1974 Switzerland (with Pincus Green); became Glencore 1994 after management buyout; Rich told biographer Ammann his 'most important and most profitable' deals violated trade embargoes; post-1979 Iran his most important crude supplier 15+ years; sale of Iranian oil to Israel via secret pipeline per Ammann biography/Forbes; 1983 US indictment on 65 counts incl. tax evasion, wire fraud, racketeering, trading with Iran during embargo

(described at the time as the biggest US tax-evasion case); never tried - fled to Switzerland, never returned; pardoned by Clinton 20 Jan 2001, widely criticised; Trafigura founded 1993 by former Marc Rich partners | Reference article; indictment allegations, not convictions

Source: en.wikipedia.org/wiki/Marc_Rich

Read for background, not cited

[2], [5], [57], [58]