

Mahogany Research Project

www.shell.com/us/mahogany/



Shell is partnering with local communities to ensure oil shale is developed in an economically viable, environmentally responsible and socially sustainable manner.

- 1985** Congress abolishes the Synthetic Liquid Fuels program after spending \$8 billion over nearly 40 years.
- 1986** U.S. government sells some oil shale lands and processes unfinished oil shale mining claims (some 50 years old).
- 1987** Shell purchases Ertl-Mahogany (17,300 acres) and Pacific (13,300 acres) oil shale properties in two Colorado counties: Rio Blanco and Garfield.
- 1990** Exxon sells Battlement Mesa as proposed Colorado retirement community.
- 1991** Occidental announces closure of C-b tract project in Rio Blanco County. Although three shafts and head frames are constructed, no retorting occurs.

Unocal produces 5 million barrels of shale oil over a ten-year period, and then terminates its Long Ridge project citing operational problems and large cash losses.

California's Lawrence Livermore National Laboratory plans to build a \$20 million experimental oil shale plant at Parachute, Colorado.

The New PARAGO Corporation states that oil shale asphalt produced at Anvil Points shows good results at several test sites.
- 1993** U.S. House of Representatives stops funding of additional oil shale tests by Lawrence Livermore Laboratory.
- 1997** Shell conducts an in situ heating process experiment on Mahogany oil shale property in Colorado. Work postponed because of economic conditions.

U.S. Department of Energy gives control of most Colorado oil shale lands (U.S. Naval Oil Shale Reserve) to the Bureau of Land Management.
- 2000** Bureau of Land Management asks for public comment on management of federal oil shale lands.

Shell returns to Mahogany oil shale property in mid-2000 with an expanded in situ heating technology research program.
- 2002** Shell restarts in situ heating test, the Mahogany Demonstration Project.
- 2004** Shell successfully completes and reclaims a small-scale, circular freeze wall test; the Mahogany Isolation Test.
- 2005** Shell determines its innovative In situ Conversion Process works on a small scale, through its Mahogany Demonstration Project South test.
- 2006** Bureau of Land Management grants approval for five oil shale research, development and demonstration leases in Colorado. Shell is granted three leases and Chevron and EGL Resources are each granted one lease.

Mahogany Research Project

Doing Oil Shale The **Right** Way

Western U.S. oil shale history

In collaboration with Dave Fishell of Grand Junction, Colorado

Hydrocarbons have been recovered from shale containing kerogen for at least 600 years. Ute Indian legends told of warriors who saw lightning hit certain rock formations causing the "rocks to burn." There is even a story of a Colorado rancher who built a rock fireplace in his new cabin. When the first flames heated the fireplace, the chimney, primarily composed of oil shale, caught fire and burned the entire structure to the ground. Pioneers in the western United States fueled their campfires with shale and used its oily residue to grease their wagon axles. Shale also was used to heat peach orchards during winters in Palisade, Colorado.

In the 1850s, small amounts of shale oil were produced in the eastern United States. However, lack of technology, prohibitive processing costs, and inexpensive and reliable foreign crude oil supplies stalled efforts to produce an economical and viable fuel source from oil shale. Oil shale development further diminished when the first crude oil well was drilled in Titusville, Pennsylvania. During World War II, the U.S. military consumed hundreds of thousands of barrels of oil. At that time, interest in developing the oil shale deposits in western Colorado was revitalized.

Oil shale — a chronology

- 1909** U.S. government creates U.S. Naval Oil Shale Reserve program.
- 1910–12** Local Colorado residents first to stake claims to oil shale lands under 1872 U.S. mining law.
- 1912–16** U.S. Geological Survey reconnaissance team surveys Colorado, Utah and Wyoming oil shale lands and estimates that 20 billion barrels of oil could be recovered from the region. Officials order second survey that estimates 40 billion barrels of oil in Green River shale formation of Colorado, Utah and Wyoming.
- 1917** First oil shale retort (mining, crushing and cooking rock in air-tight kilns) in Colorado is built on Dry Fork northwest of De Beque.
- 1918–25** First "oil shale boom" with 30,000 to 35,000 oil shale land and mining claims filed — the majority in Colorado's Piceance Basin. Dozens of oil shale companies are formed in Colorado.



By heating the oil shale underground, Shell has a higher recovery efficiency than previous oil shale processes.



Mahogany Research Project

www.shell.com/us/mahogany/



Shell is partnering with local communities to ensure oil shale is developed in an economically viable, environmentally responsible and socially sustainable manner.

- 1920** U.S. government passes Mineral Leasing Act specifying future Bureau of Land Management oil shale land can only be leased through U.S. Secretary of Interior.
- 1924–29** The U.S. Bureau of Mines extracts 3,600 barrels of oil from an experimental retort near Rulison, Colorado. Production ceases when oil fields are discovered in California, Texas and Oklahoma.
- 1944** Anvil Points, on U.S. Naval Oil Shale Reserve land west of Rifle, Colorado, receives \$18 million for various experimental oil and gas technologies from U.S. Synthetic Liquid Fuels Act.
- 1949–56** U.S. Anvil Points mines open in the Mahogany Ledge of the Roan Cliffs in Colorado, and three different types of retorts are built, along with housing. Some high-cost oil is produced before project ceases operations.
- Early 1950s** Gulf Oil purchases 3,700 acres of Colorado oil shale land. Shell purchases 4,500 acres of oil shale land at Red Pinnacle in Colorado.
- 1955–61** Union Oil of California (Unocal) builds oil shale plant north of Parachute, Colorado, applying "Union A" retort process. Plant operates for 18 months and produces as much as 800 barrels per day of shale oil. Operation is shut down due to operational problems and price uncertainties.
- 1964–72** The Oil Shale Company (Tosco), along with partners Standard Oil Company of Ohio (Sohio) and Cleveland-Cliffs, builds and operates the Colony oil shale plant 17 miles north of Parachute, Colorado. The plant produces about 270,000 barrels of shale oil by 1972.
- 1966–67** CER Geonuclear Co., in partnership with oil companies and U.S. Atomic Energy Commission, announces "Project Bronco," a 50 kiloton atomic "device" to be detonated underground in the Piceance Basin to recover oil from shale. The plan is never implemented.
- 1966–82** PARAHCO Company, in partnership with 17 companies and the U.S. government, operates new Anvil Points facility. Secret agreement calls for producing oil for U.S. Navy. Although some refined oil shale products and fuel are actually tested and used by the Navy, retort problems and high costs force the program to close.
- Early 1970s** Shell conducts in situ (in-ground) steam injection research in oil shale and Nahcolite located in Piceance Basin in Rio Blanco County, Colorado. Company later abandons process, which is now the basis for American Soda's Nahcolite recovery project.
- 1972–77** Superior Oil Company announces plans for a new oil shale plant near Meeker, Colorado. Besides shale oil, company claims plant will also recover Nahcolite, alumina and soda ash. The plant is never built.

- 1972–82** Occidental Petroleum Company conducts first in situ oil shale experiment along Logan Creek north of De Beque, Colorado. Six retorts of various sizes are built and oil is produced. The project is too costly and eventually shuts down.
- 1974** Federal government agrees to lease two tracts of oil shale lands (Tract C-a and C-b) to various companies in Piceance Basin. Shell, Atlantic Richfield Company (ARCO), Tosco, and Ashland Oil are the original partners of Tract C-b, and American Oil Company (Amoco) and Gulf Oil are partners in Tract C-a. Union Oil develops a new oil shale technique called the "Union B" retort process. Shell and Ashland Oil join Colony project.
- 1976–78** Unocal plans new commercial-scale oil shale plant along Parachute Creek to be constructed near Parachute, Colorado if and when "necessary investment climate" develops. Imported oil reaches \$41 a barrel.
- Late 1970s** Shell sells out of Colony Project along with Ashland Oil, Cleveland-Cliffs and Sohio, leaving Arco and Tosco with 50-50 vested interest. At Tract C-b, Shell and original business partners sell federal lease to Occidental and Tenneco.
- 1980** Congress approves \$14 billion for synthetic fuels development. Exxon buys ARCO's 60 percent interest in Colony oil shale project for \$400 million. Exxon and Tosco begin construction of the Colony II plant, estimated to produce 47,000 barrels of shale oil per day by 1987. Unocal announces plans for larger Long Ridge operation near Parachute, Colorado to process 50,000 barrels of shale oil per day by 1990. Amoco produces about 1,900 barrels of in situ shale oil at C-a Tract in Rio Blanco County.
- 1981** Unocal begins construction of the Long Ridge project applying the "Union B" retort process, and Exxon-Tosco begin construction of Colony II applying the Tosco II retort process. Exxon starts company town of Battlement Mesa south of the Colorado River near Parachute, Colorado. Amoco conducts second largest in situ retort demonstration at C-a tract and produces 24,400 barrels of shale oil.
- 1982** Oil demand drops in U.S. and abroad and cost per barrel falls dramatically. On "Black Sunday" (May 2nd), Exxon announces closure of Colony II project, citing higher than expected construction costs and less demand for oil. The project is only semi-operational at closure. Unocal states it will continue construction of the Long Ridge project north of Parachute, Colorado.
- 1982–83** Shell conducts new experimental in situ heating process test on Shell's Red Pinnacle Property north of De Beque, Colorado. Work continues in company labs.

