COLORADO ENERGY BALANCE -1981

Plate 1: Coal Production and Distribution and Electrical Power Generati.
Plate 2: Oil and Gas Production, Movement and Consumption
Plate 3: Uranium, Oil Shale and Geothermal Production, Movement and Consumption

Compiled by: W.A. Brackett
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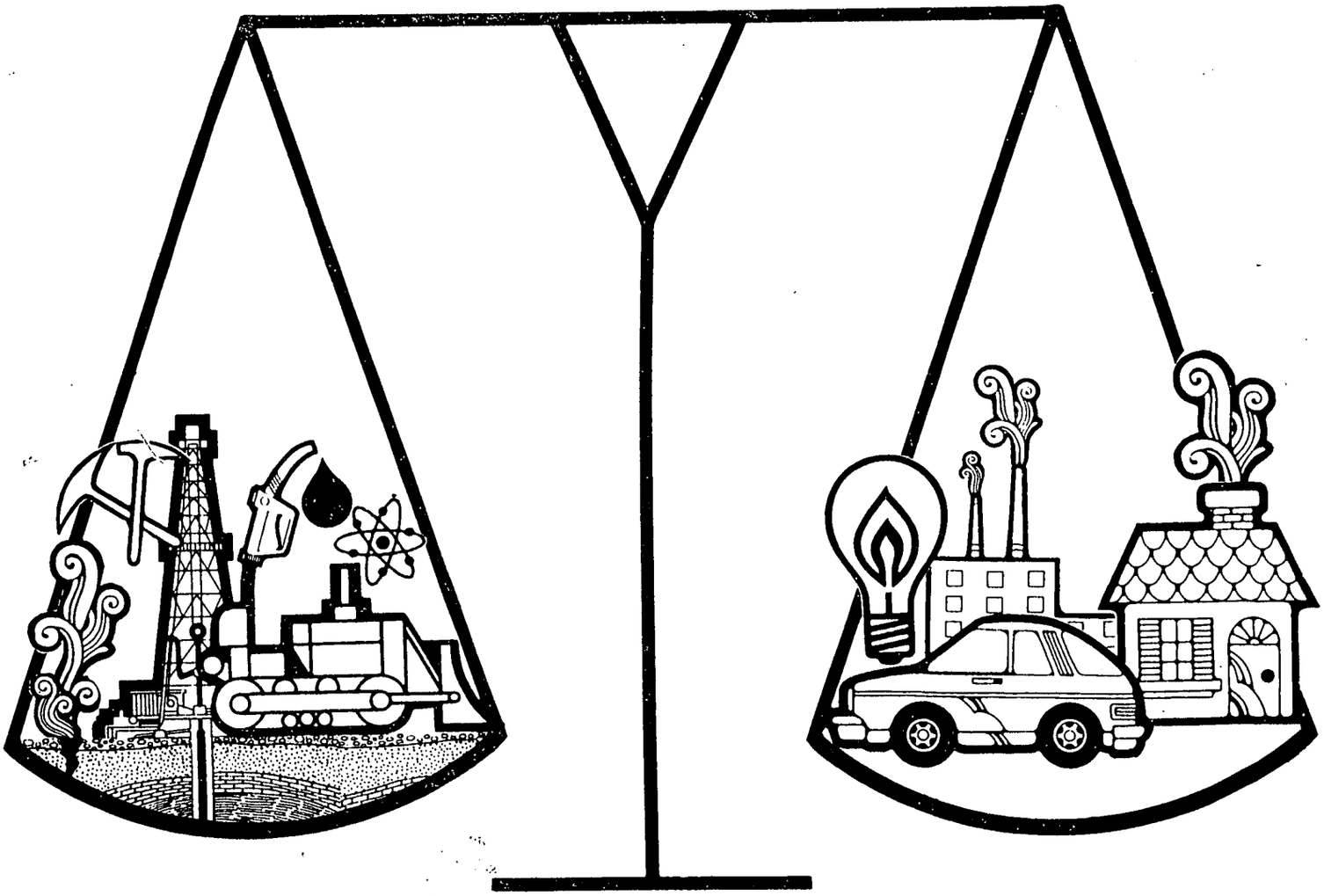
W.R. Taylor
L.R. Ladwig



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1/3

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Dr. John P. Byrden of the University of Denver, coordinator of the Energy Management Program directed these internships while L. R. Ladwig, Mineral Fuels Section Chief, Colorado Geological Survey, provided direction and technical assistance.

The Colorado Geological Survey provided the drafting and printing for this set of maps.

L. R. Ladwig,

Colorado Geological Survey

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COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES
JOHN W. ROLD, DIRECTOR

COLORADO ENERGY BALANCE - 1981 Plate 3

URANIUM, OIL SHALE, AND GEOTHERMAL PRODUCTION, MOVEMENT AND CONSUMPTION

COMPILED BY WILLIAM A. BRACKETT*, RODNEY C. GARRISON*, AND L. R. LADWIG**

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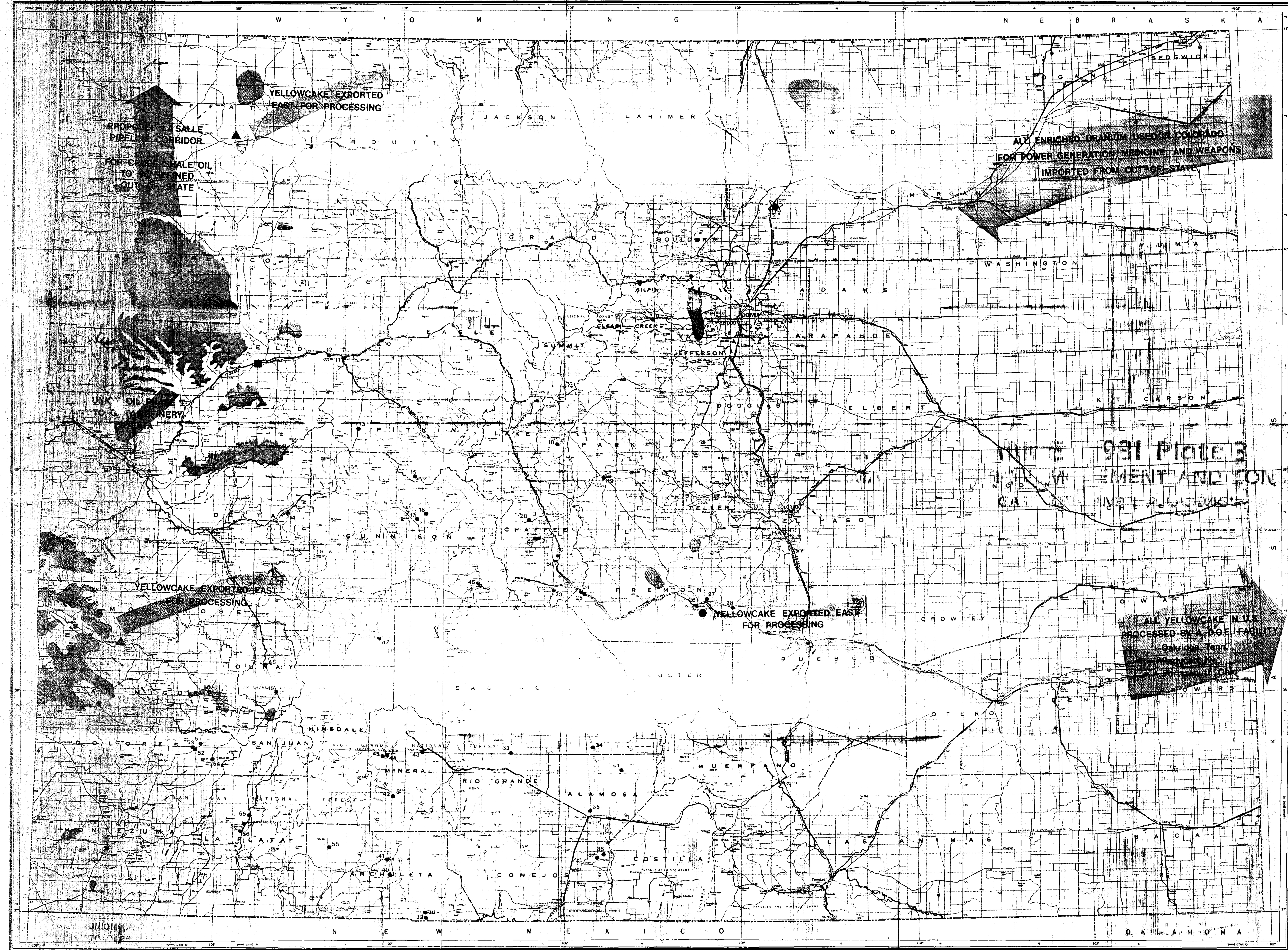

Base from U.S. Geological Survey

Drafted by Anne Magee

Scale 1:1,000,000

*Graduate Student, University of Denver Graduate School of Business, Energy Management Program

**Chief, Mineral Fuels Section, Colorado Geological Survey

EXPLANATION

OIL SHALE

Oil shale occurrence area

Product movement

GEOTHERMAL

● 38 Geothermal spring or well and site no.

URANIUM

Uranium mine

Uranium processing mill

Vanadium processing plant

Nuclear power plant

Uranium occurrence area

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OIL SHALE

The Piceance Basin of western Colorado contains some of the richest oil shale deposits in the world. These oil shales were deposited in ancient lakes during Eocene time--some 50 to 60 million years ago. The Green River Formation oil shale is technically a sedimentary marlstone composed of dolomite, calcite, clay minerals, feldspar, and quartz containing syngenetic kerogen, a solid organic material which yields shale oil, hydrocarbon gases, and carbon when heated to 900°F.

Colorado oil shale resources are placed at a total of 1200 billion barrels in beds at least 100 feet thick that contain over 30 gal/ton and 840 billion barrels in lesser deposits 15 feet thick and at least 15 gals/ton. This makes the Piceance Basin, slightly more than 1500 sq. miles, one of the richest single hydrocarbon deposits in the world.

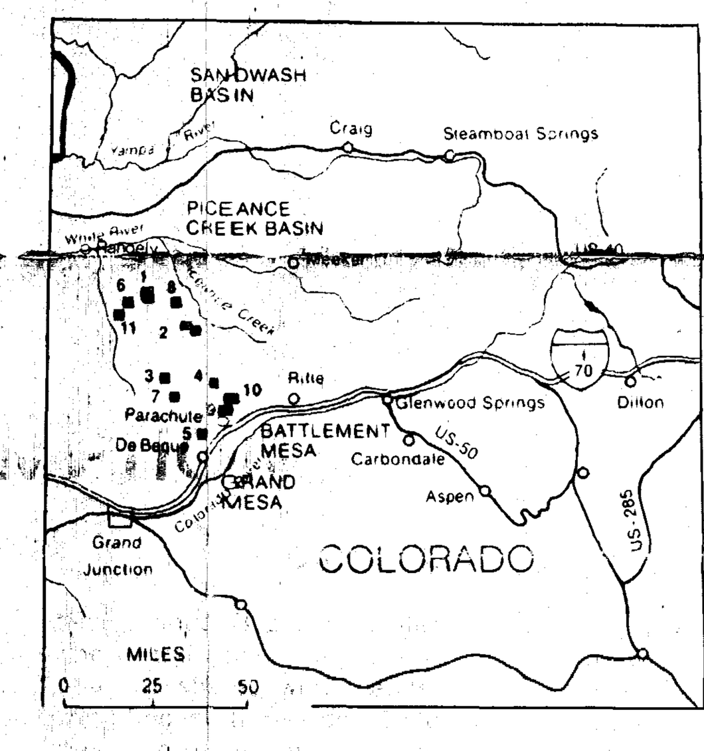
Associated with the Green River Formation are sodium-carbonate minerals. In Colorado these are nacholite ($NaHCO_3$), a potential source of dry industrial stack gas sulfur scrubbing agent, and dawsonite ($NaAlCOH_3CO_2$), a potential source of alumina. Estimated resources of these minerals in Colorado is 29 billion tons of nacholite and 19 billion tons of dawsonite.

Development of these resources during 1981 indicated commercial production by mid 80s to late 80s, but recent changes in world oil prices and demand have generally set back most of these schedules.

During 1981 approximately 196,000 bbls of oil was produced by Occidental at Logan Wash, and 26,320 bbls by Rio Blanco Oil Shale Company.

Source: U.S. Geological Survey

1982 COLORADO OIL SHALE ACTIVITY



1. C-a Rio Blanco (Gulf, Std. Indiana)
2. C-b Cathedral Bluffs (Occidental, Tenneco)
3. Clear Creek Shale Oil Project (Chevron, Conoco)
4. Colony Shale Oil Project (Exxon)
5. Logan Wash (Occidental)
6. Mahogany Shale Project (Phillips)
7. Pacific Shale Project (Sohio, Cleveland-Cliffs, Superior)
8. Horse Draw (Mult. Minerals)
9. Parachute Project (Mobil Oil)
10. Parachute Creek Shale Oil Program (Union Oil)
11. BX In-Situ Oil Shale Project (Equity Oil)

Source: **Shale Country**, 1983

URANIUM

Current uranium ore production in Colorado comes from two major, geologically distinct areas, the Central City area and the Uravan Mineral Belt. Other areas of uranium mineralization include protions of Moffat, Saguache, and Weld Counties, which have produced or may produce in the future.

The Schwartzwalder Mine, about eight miles northwest of Golden, in the Central City uranium area, is the largest uranium mine in Colorado and is a prime example of vein-type uranium deposits in North America. Uranium from this mine occurs as veins of pitchblende associated with sulfide minerals.

The Uravan mineral belt is an arcuate belt extending from western Montrose and San Miguel Counties through southwestern Mesa County and into eastern Utah. Ore bodies are contained in continental sandstones with the mineralized rock forming elongate, podlike masses and irregular bodies called "rolls." Numerous small mines produce ore in this area.

After the uranium ore is mined, it is shipped to either the Cotter Corporation mill in Canon City or the Union Carbide Corporation mill in Uravan. A small amount of ore is purchased by General Electric at its buying station in Naturita and shipped to Blanding, Utah. Also, one company ships ore from another state to be milled in Colorado and two mines export ore to be milled in another state. At these mills uranium concentrate called "Yellowcake" is produced from uranium ore. Concentrate is also produced using the heap-leaching process, extracting uranium from old uranium tailings. Two plants in Colorado use this method and produce a very small amount of concentrate. From both types of plants, the uranium is shipped to a federal enrichment plant.

After the ore is processed into enriched uranium, most is used as fuel for nuclear power plants. Colorado has one such plant at Plattville (Fort St. Vrain), a high temperature helium cooled reactor, utilizing thorium as well as uranium as feed stock. During 1981 this plant generated 750,480 kwh of electricity.

1981 COLORADO URANIUM STATISTICS

ORE PRODUCTION-FROM 67 MINES	480,000 TONS*
CONCENTRATE PRODUCTION (YELLOWCAKE)	900 TONS
CONSUMPTION (EQUIVALENT TO YELLOWCAKE)	20 TONS
NET EXPORT (YELLOWCAKE)	880 TONS

*Equal to 1200 tons of yellowcake at .25 U_3O_8

Source: U.S. Department of Energy

COLORADO URANIUM RESOURCES (1977)

Tons U_3O_8 Yellowcake*

Potential Resource

PROBABLE	POSSIBLE	SPECULATIVE	TOTAL**
101,000	82,000	37,000	220,000

* At forward cost of $30/lb U308

** An estimated 3,750 tons of U308 **reserves** were delineated along the Front Range of Colorado since this estimate.

Source: Colorado Energy Resource Handbook, Volume 3-Uranium. Colorado Energy Research Institute, December 1977

Donna Collins, Colorado Geological Survey

1982 - COLORADO OIL SHALE PROJECTS

Project	Index No.	Technology	Estimated Production	Current Update (April 1983)
Ca Tract **Rio Blanco Oil Shale Co.** Gulf Oil, Standard Indiana	1	Original plan was modified-in-situ. Presently developing plans for an open pit with surface retorting	No estimate of future production. Produced 26,300 Bbls oil from in-situ burn.	Completing a Lurgi pilot plant in Hannaville, PA and trying to obtain 6400 acres for off-tract disposal.
Cb Tract **Cathedral Bluffs Oil Shale Co.** Occidental, Tenneco	2	Original plan was modified in-situ. Present plans for modified in-situ and above-ground retorting	[illegible]ected 13,500 Bbls/day by [illegible] if funding is approved.	Applied to U.S. Synthetic Fuels Corp. for loan guarantee. Continuation of project depends upon this funding.
Clear Creek Shale Oil Project Chevron Shale Oil Co. (Standard California), Conoco	3	Underground and open-pit mining with surface retorting and upgrading. Staged turbulent bed retort	Ultimate 100,000 Bbls/day. Phased development of 10,000 Bbls/day (25,000 Tons-shale/day)	Plan first phase construction to start in 1985, production by mid-1990s. Currently building a 350 ton/day semiworks at Salt Lake City.
Colony Shale Oil Project Exxon	4	Underground mining, surface retorting using TOSCO II RETORT	Between 1965-72 produced 180,000 Bbls oil at a semiworks retort and demonstration mine. Proposed 450,000 Bbls/day by mid-1980s	May 1983. Exxon phased out entire project. Retaining a work force for maintenance and reclamation.
Logan Wash Occidental	5	Location of modified in-situ experiments	During early 1982 retorts 7 and 8 were burned producing 196,000 Bbls oil.	Research winding down, with only retort monitoring and reclamation work continuing.
Mahogany Shale Project Phillips	6	No specifics as to process type.	No announced plans.	Site exploration and offsite studies being conducted.
Pacific Shale Project Sohio, Cleveland-Cliffs, Superior	7	12,600 acres private land, room and pillar mine, above ground Superior Circular Grate Retort	100,000 Bbls/day by late 1990s, start-up by 1990. Uses 164,760 TPD raw shale.	In planning stage, with a Draft EIS due in late 1983.
Horse Draw Multi-Mineral Corporation	8	Underground mine, for recovery of shale oil, nacholite and dawsonite.	Research in conjunction with USBM. Company research facility 85% complete in Grand Junction. No specific plans for production.	Project on hold.
Parachute Project Mobil Oil	9	Hold 10,000 acres. Underground room and pillar mine, surface retort.	Projected 100,000 Bbls/day (160,000 TPD raw shale) by late 1990s.	In planning stage, with a Draft EIS due in late 1983.
Parachute Creek Shale Oil Program Union Oil	10	Underground mine with surface retort. 20,000 acres oil shale, 10,000 acres valley land.	Phase I-10,000 Bbls/day in late 1983, the first commercial shale oil project in U.S. Phase II - 90,000 Bbls/day by 1994.	Construction proceeding with start-up late in 1983. Ten-year contract with DOD for 33 million barrels military diesel and jet fuel. Seeking Synthetic Fuels Corp. assistance for Phase II.

RESOU[illegible]

1981 COLORADO U[illegible] AND M[illegible]

County	No. Mines	No. Mills
Fremont		
Gilpin	1	
Jefferson	1	
Mesa	14	
Montrose	35	
Saguache	1	
San Miguel	15	

Source: Colorado Division of Mines

GEOTHE[illegible]

The geothermal resources represented by the 61 therma[illegible] throughout the western one-[illegible] resources, which can be [illegible] hydrothermal resources, range [illegible] low of 70°F to a high of 18[illegible] complexity of western Colo[illegible] comment can be made re[illegible] conditions surrounding these [illegible] all the areas appear to be fa[illegible] associated with rocks ra[illegible] Precambrian to Recent.

Preliminary evaluation of each [illegible] that the 61 thermal are[illegible] 4,880,000,000,000,000 to [illegible] B.T.U.'s of heat energy [illegible] Exploration work by major [illegible] failed to locate any area in C[illegible] characteristics suitable [illegible] electricity.

While the hydrothermal reso[illegible] scattered throughout western [illegible] areas are found in close proxi[illegible] the thermal waters could be [illegible] direct application uses. For [illegible] used for district heating syste[illegible] developed in Pagosa Springs, [illegible] other uses as:

Space heating
Greenhouses
Fish farming
Recreation

Development of Colorado's h[illegible] has slowed recently due [illegible] economy and prices of energy [illegible] the late 1970's showed that [illegible] of Colorado could play an im[illegible] the energy needs of local are[illegible]

Source: Colorado's Hydrot[illegible] An Assessment [illegible] Resource Series [illegible] Survey.

COLORADO GE[illegible] SITE CHARA[illegible]

Site

Antelope Warm Springs
Birdsie Warm Springs
Brand's Ranch Well
Brown's Canyon Warm Spgs
Browns Grotto Warm Spgs
Canon City Warm Springs
*Cebolla Hot Springs
*Cement Creek Warm Spg
*Clark Artesian Well
Colonel Chinn Well
Conundrum Hot Springs
*Cottonwood Hot Springs
Craig Warm Water Well

Dexter Warm Spring
Don K. Ranch Well
Dotsero Warm Spring
*Dunton Hot Spring
Dutch Crowley Well
*Eldorado Springs
Eoff Well
*Penrose Artesian Well
*Fremont Natatorium Spg
Fullinwider Warm Spring
Geyser Warm Spring
*Glenwood Hot Springs

Hartsel Hot Springs
Haystack Butte Well
Hortense Hot Spring
*Hot Sulphur Springs
*Idaho Hot Springs
*Juniper Hot Springs
*Lemon Hot Springs
Mapco State Well 1-32
*McIntyre Warm Springs
*Mineral Hot Springs
*Mt. Princeton Hot Spgs.

*Orvis Hot Springs
*Ouray Hot Springs
*Pagosa Springs
Paradise Hot Springs
*Penny Hot Springs
Piedra River Warm Spgs.
*Pinkerton Hot Springs
*Poncha Hot Springs
Rainbow Hot Springs
*Ranger Warm Springs
*Rhodes Warm Spring
Rico
Routt Hot Springs

*Sand Dunes Well
*Shaws Warm Spring
South Canyon Hot Spg.
*Splashland Well
*Steamboat Springs
Stinking Springs
Stratton Warm Spring
Swissvale Warm Spring
*Tripp/Trimble Hot Spgs.
*Valley View Hot Springs
*Wagon Wheel Gap Spgs.
*Lower and Upper Waunita Hot Springs
*Wellsville Warm Spg.

*Currently developed for [illegible]