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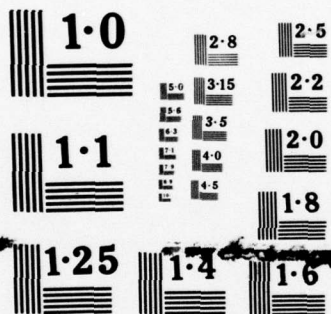
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ENERGY ATLAS OF COLORADO

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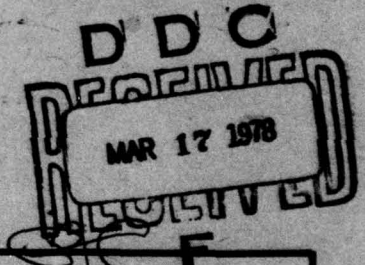
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SEPTEMBER 1977
FINAL REPORT



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DEAN OF THE FACULTY
UNITED STATES AIR FORCE ACADEMY
COLORADO 80840

Editorial Review by Captain Rockwell
Department of English
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This research report is presented as a competent treatment of the subject, worthy of publication. The United States Air Force Academy vouches for the quality of the research, without necessarily endorsing the opinions and conclusions of the author.

This report has been cleared for open publication and/or public release by the appropriate Office of Information in accordance with AFR 190-17 and DODD 5230.9. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service.

This research report has been reviewed and is approved for publication.

Philip J. Endle
PHILIP J. ENDLE, Colonel, USAF
Vice Dean of the Faculty

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Presents the locational aspects of the energy resources available in Colorado. Resources include coal, oil and gas, uranium, oil shale and water. The location of power plants and power transmission lines are also indicated as those for water resources. ↑		

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TABLE OF CONTENTS

INTRODUCTION.	2
LOCATION MAP.	3
LANDFORMS	5
COAL.	7
OIL AND NATURAL GAS	9
GEO THERMAL, OIL SHALE, AND URANIUM.	11
WATER RESOURCES	13
POWER PLANTS AND TRANSMISSION LINES	15
ENERGY PRODUCTION AND CONSUMPTION	17

INTRODUCTION

This atlas provides an overview of Colorado's energy resources. Because of the scale of the maps in the atlas, data presented is often generalized. We anticipate that this form of presentation will be of use to those desiring the "big picture." The atlas is the offshoot of a series of maps and overlays prepared by cadets enrolled during the past three years in Geography 340, Cartography, at the Air Force Academy. We have updated the data used in the production of their maps for this atlas. In many cases, data which were desired for inclusion in the atlas were not available due to factors such as public disclosure laws, a lack of compilation, and incomplete records. We would like to express appreciation to District VIII of the Federal Energy Administration for their assistance in this project.

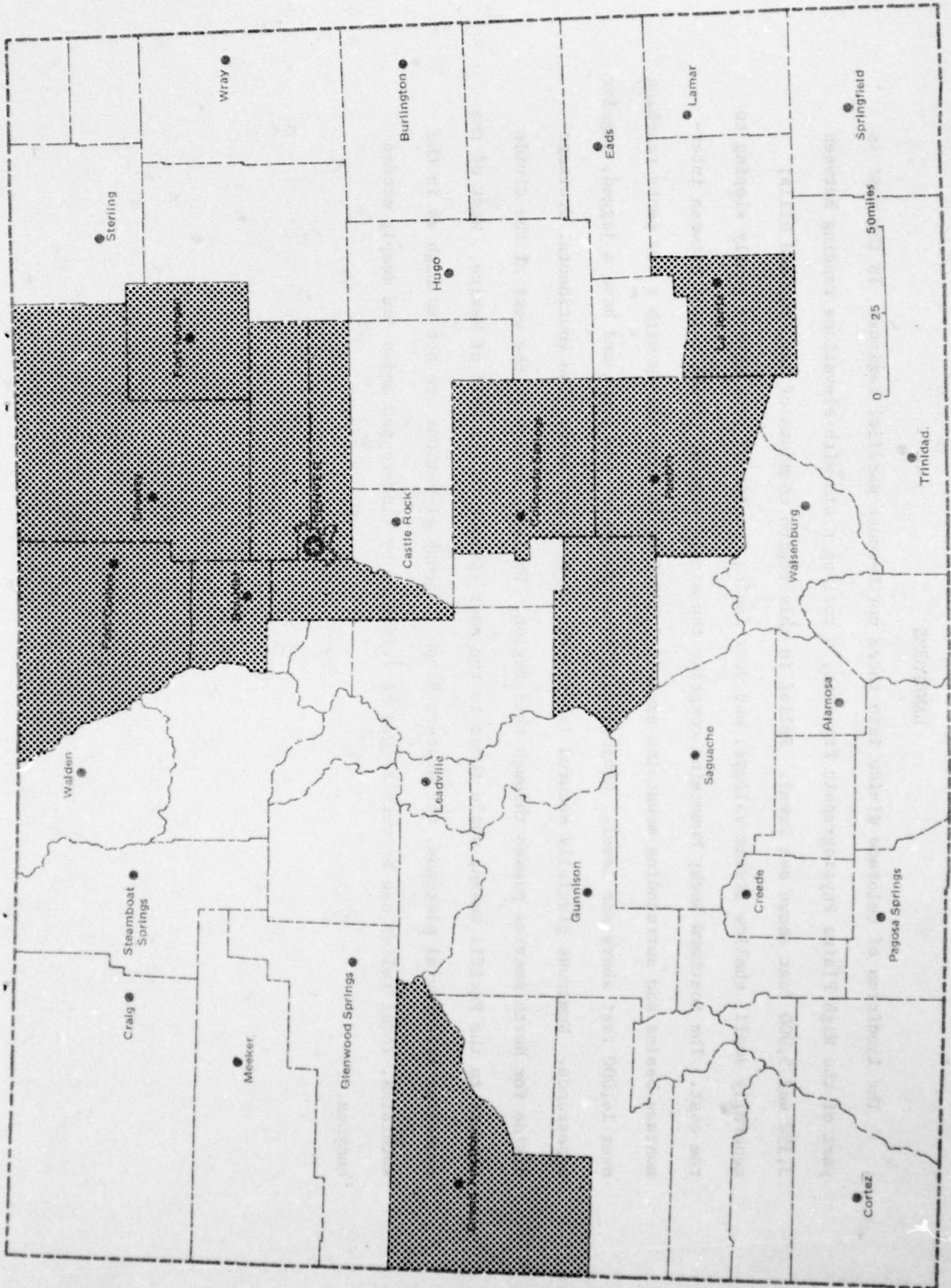
A location map and a map of landforms precede the energy resources maps of the state. We have separated the state resources into four major groupings: coal; oil and natural gas; geothermal, oil shale, and uranium; and water. In addition, we have included a map of power plants and associated transmission lines. The final map contains statistics on Colorado's import, production, and export of energy.

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LOCATION MAP

Colorado's population is concentrated in a narrow belt at the juncture of the Rocky Mountains and Great Plains. Principal cities in this area include Fort Collins, Greeley, Boulder, Denver, Castle Rock, Colorado Springs, and Pueblo. Commonly referred to as the Front Range Urban Corridor, this north-south belt extends northward into Wyoming. It is the only major commercial, industrial, and transportation center between Kansas City and the West Coast. The cities outside of the corridor are regional centers for farming, mining, or recreation areas.

Those counties with 20,000 or more people are screened



LANDFORMS

The landforms of Colorado divide into three north-south parallel regions. In the east is part of the High Plains Physiographic Province, a rolling plain with elevations ranging between 3,350 and 5,000 feet above sea level. Relief in this region consists of low, rounded hills; generally small, shallow stream valleys; and west-facing cuestas of rock strata gently sloping to the east. The Southern Rocky Mountains comprise the middle region. Local relief between intermontane basins and surrounding mountains exceeds 3,000 feet in some places with a few peaks reaching over 14,000 feet above sea level. Geologically these mountains are young and have a jagged, angular appearance. Numerous glacially scoured landscapes can be found here. The continental drainage divide for North America passes through this region. Drainage basins to the west of the divide connect to the Pacific Ocean, while those to the east connect to the Gulf of Mexico. West of the mountains are several plateaus, the Western Slope. Though elevations are not as high as in the mountains, local relief can be very rugged as evidenced by flat-topped mesas and deeply eroded canyons.

LANDFORMS



COAL

Coal deposits are generally located where recent geological tectonic activity has been at a minimum (away from the highly rugged mountainous areas). Extensive seams are located beneath the eastern plains; the coal here is primarily bituminous. The Raton Field in the southeast has been a traditional cost source for the Colorado Fuel and Iron Company in Pueblo. The fields to the east of Denver and Colorado Springs also have been important major producers. It was the coal from this area, the Denver Basin, which led the geologists in the 1871-1873 Hayden Survey party to believe that Colorado would have great prosperity. Indeed, seams in this area fueled smelting operations for the ores mined in the nearby mountains. The coal mines still in operation in this area supply local thermal electric power plants. If the cost of delivered coal should go up, it is possible that some of the inactive mines might reopen to supply these local power plants. Coal is common on the Western Slope, and the early development of railroad and mining towns depended on these deposits. Bituminous as well as anthracite coal occur in this region. In addition, there are several extensive deposits of lignite. Except in the northwest, these deposits are not extensively mined today.

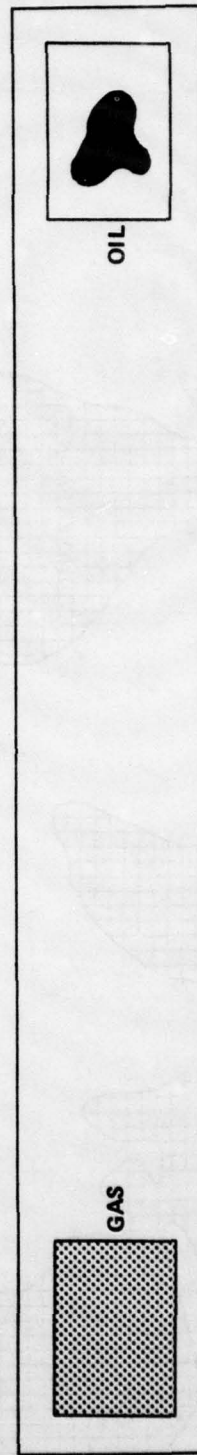
COAL FIELDS



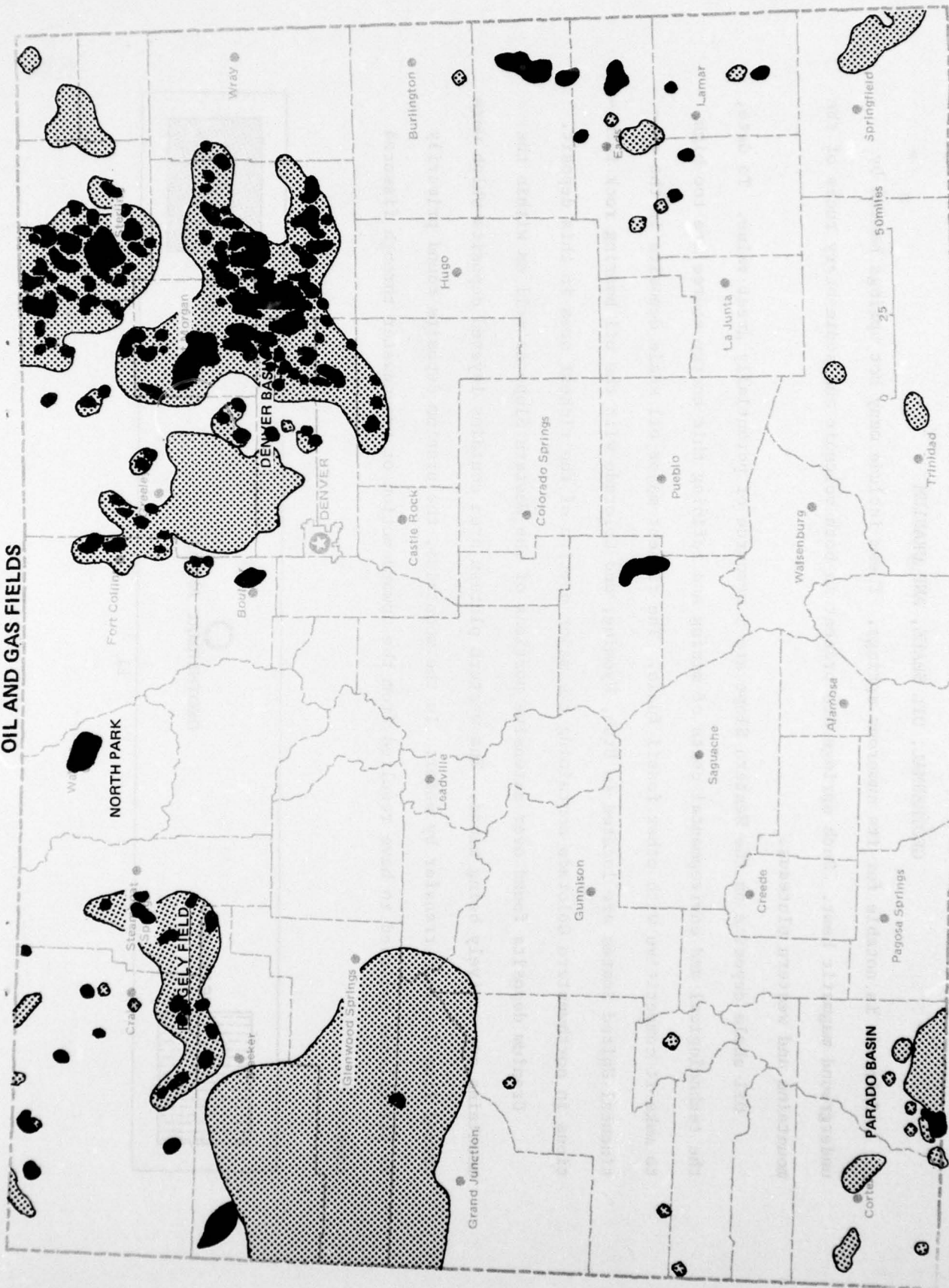
OIL AND NATURAL GAS

The largest deposits of oil and natural gas occur in the high plains to the northeast and the plateaus of the Western Slope. Additionally, small deposits are present in the southwest, southeast, and in the North Park area of the north central mountains. The Denver Basin area in the northeast contains small individual oil pools in buried ancient beach sands. In contrast, the Rangely Field of northwestern Colorado has pools trapped in a buried dome or anticlinal structure. As in the Denver Basin, the field in the southeast also contains small potentially productive pools. The field in the southwest is only a small part of the Parado Basin which is mined principally in adjacent states.

Production varies in these fields, but the Rangely Field is the most productive area in the state.



OIL AND GAS FIELDS

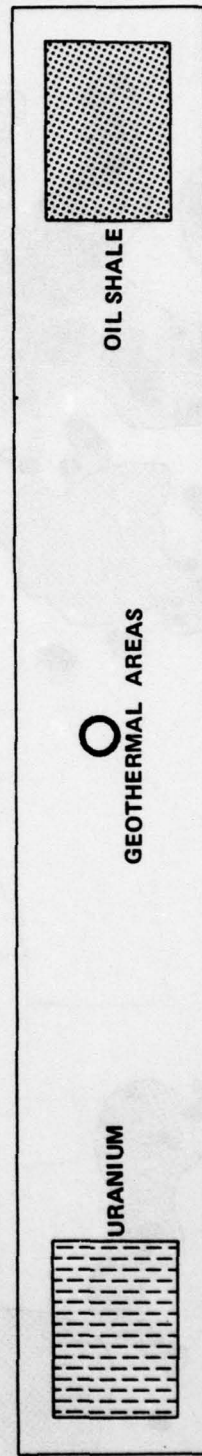


GEOHERMAL, OIL SHALE, AND URANIUM

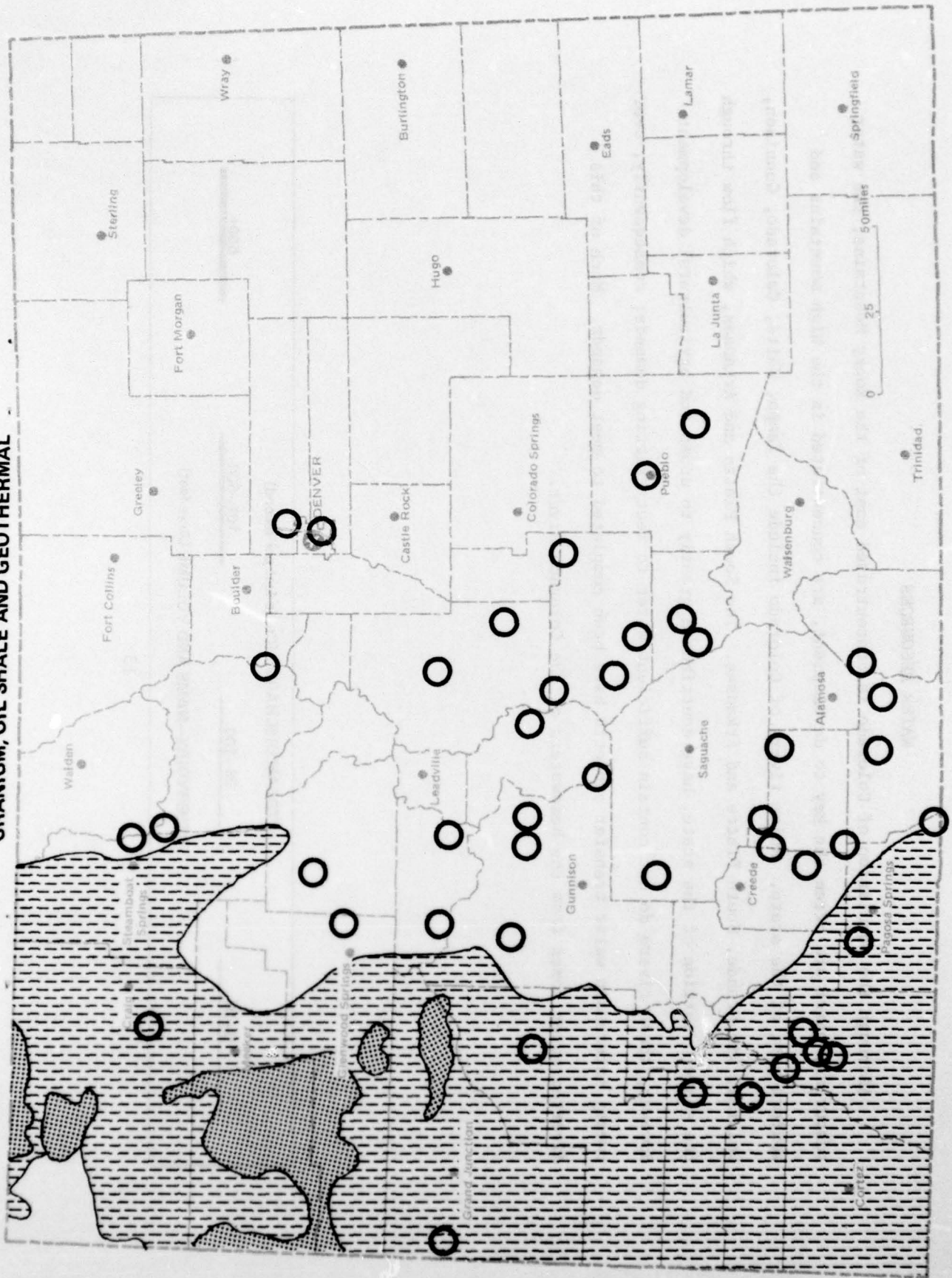
Colorado is notable for its numerous springs. These include many hot springs heated by underground magmatic heat. Such springs are present in both volcanic and sedimentary rocks of the mountains and western plateaus.

Oil shale deposits on the Western Slope are a resource of potentially great value. To date, the technological and environmental costs of mining and refining this energy source are too high to make it competitive with other fossil fuels. The richest major oil shale deposits in the continental United States are located in Utah, Wyoming, and Colorado with the oil bearing rock formations in northwestern Colorado containing the major portion of the richest ores in this deposit.

Uranium deposits found over extensive portions of the Western Slope as well as within the mountains are actively being mined. The western plateau area contains layered deposits which were formed from downward transfer by water. In the mountains, the uranium deposits found primarily in pitchblende believed to have resulted from the upward motion of groundwater through fissured rock.



URANIUM, OIL SHALE AND GEOTHERMAL

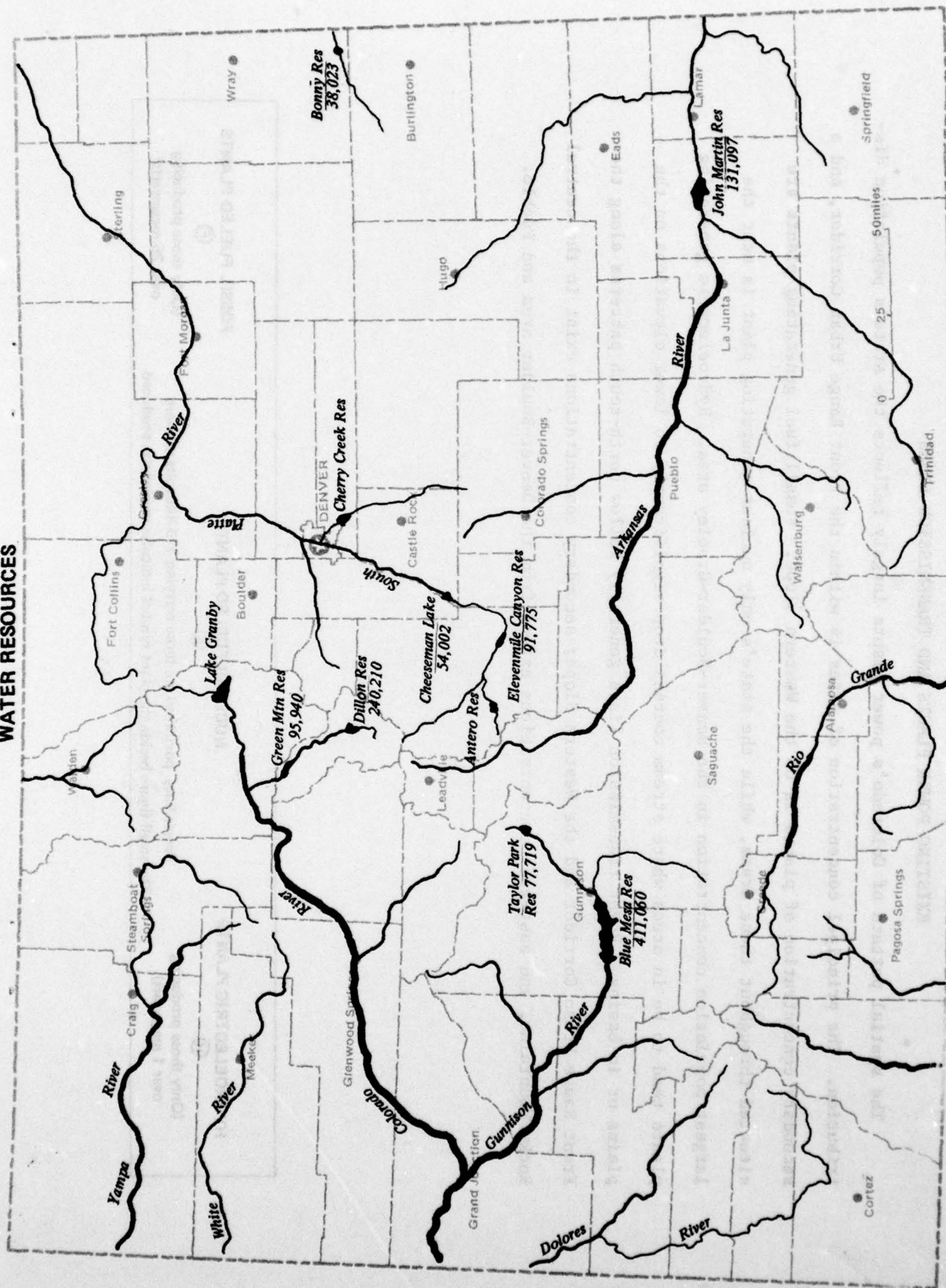


WATER RESOURCES

Although the population of Colorado is concentrated east of the Rocky Mountains, the water resources, which are often the key to development, are concentrated in the high mountains and western part of the state. Major rivers of Colorado include the Yampa, White, Colorado, Gunnison, Dolores, Rio Grande, South Platte and Arkansas. The South Platte and Arkansas, which flow through the eastern portion of the state, have contributed greatly to urban and agricultural development. However, these rivers do not contain sufficient water to meet existing demands; consequently, over twenty interbasin water transfer projects have been completed to meet demands. Much of this diverted water comes from the headwaters of the Colorado River.

STREAM DISCHARGE (Cubic feet per second)			
0-25	26-100	101-500	500+
RESERVOIRS—NAME AND VOLUME (Acre feet)			

WATER RESOURCES



EXISTING POWER PLANTS AND TRANSMISSION LINES

The spatial pattern of Colorado's power plants largely reflects the state's population distribution. The principal concentration of sites is within the Front Range Urban Corridor, and a secondary concentration of plants is on the Western Slope. Fossil fuel generating plants are situated throughout these areas, while the state's only nuclear generating plant is near the largest population concentration in the Denver-Boulder-Greeley area. Hydroelectric generating plants tend to be in areas where stream courses drop significantly to lower elevations on the plains or in basins. Power transmission lines generally follow north-south patterns along the Front Range Urban Corridor and the Western Slope; secondary concentrations exist in the central Rocky Mountains, and east-west concentrations extend from the Denver-Boulder area and Pueblo.

HYDROELECTRIC PLANTS

(H)

(Only those producing
over 1 megawatt)

NUCLEAR FUELED PLANTS

(N)

Power lines portrayed are those carrying 115 kilovolts or more
The small figure beside the plant symbol indicates megawatts produced

FOSSIL FUELED PLANTS

(F)

(Only those producing
over 25 megawatts)

POWER PLANTS AND POWER LINES

This map illustrates the power infrastructure in Colorado, showing the locations of power plants and the network of power lines connecting them. The map includes major cities and towns, as well as a scale bar indicating distances up to 50 miles.

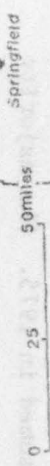
Power Plants:

- Hydro (H):** 45, 8.1, 5, 20, 3, 21.6, 14.4, 100, 120, 60, 3.6, 8, 14, 3, 5, 1, 2, 101, 232, 300, 1.4, 715.5, 375.75, 330, 4.5, 71.5, 33.25, 180, 66, 4.86, 8.64, 37.95, 38.5, 44.65, 35.5, 26, 36.
- Fossil (F):** 180, 66, 4.86, 8.64, 37.95, 38.5, 44.65, 35.5, 26, 36.

Power Lines: The map shows a complex network of power lines connecting these plants. Key lines include the Front Range, South Platte, and Colorado River lines.

Major Cities and Towns: Fort Collins, Greeley, Sterling, Fort Morgan, Wray, Burlington, Hugo, Eads, Lamar, La Junta, Pueblo, Trinidad, Walsenburg, Alamosa, Saguaiche, Creede, Gunnison, Leadville, Castle Rock, Boulder, Denver, Walden, Steamboat Springs, Craig, Meeker, Glenwood Springs, Grand Junction, Cortez, Págoza Springs.

Scale: 0, 25, 50 miles.



ENERGY PRODUCTION AND CONSUMPTION

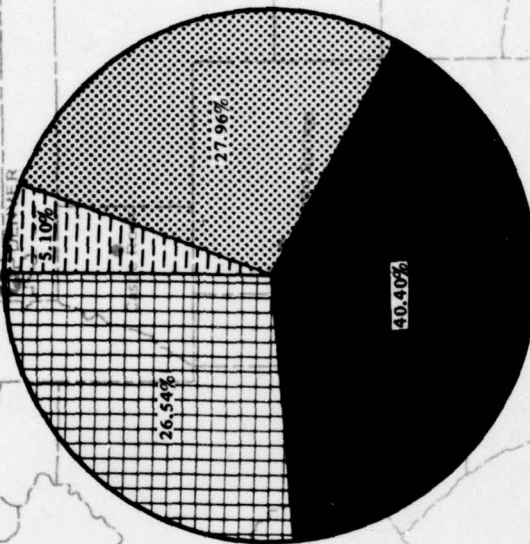
Colorado imported a little over 33 percent of the energy it consumed in 1975. The majority of this energy had been produced from gas. Most of the energy produced within Colorado came from oil. Coal was the source of all energy exported from the state. The production levels for the various energy sources are generally proportional to the resources of the state; however, as previously mentioned, coal resources may be developed in the future.

COLORADO ENERGY PRODUCTION

(Trillions of BTU's)

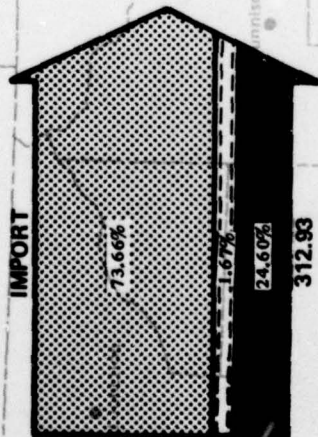
PRODUCTION 622.70

CONSUMPTION



929.34

IMPORT



312.93

EXPORT



6.29

HYDROELECTRIC



OIL



GAS



COAL



0 25 50 miles

