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Figure 1. Presentation ceremony of bound set of complete coverage of 7.5-minute topographic maps, January 26, 1973. As a result of a $9 million cooperative program, detailed maps are available for the entire Commonwealth. Participants from left to right are: H. W. Webb, Division of Mineral Resources; P. F. Bermel, Chief, Eastern Mapping Center, U. S. Geological Survey; J. L. Calver, State Geologist; V. E. McKelvey, Director, U. S. Geological Survey; M. M. Sutherland, Director, Department of Conservation and Economic Development; Governor Linwood Holton; M. B. Rowe, Secretary of Commerce and Resources; A. K. Hunsberger, Director of Engineering, Department of Highways.

TOPOGRAPHIC MAPS - VACATION HELPERS

With the arrival of spring weather millions of Americans are thinking about outdoor activities and planning their annual vacation. For the first time, detailed 7.5-minute series topographic maps are available for all of Virginia. By means of standard colors and symbols, information on works-of-man as well as those of nature are now available in map form. To plan where to vacation, fish, hunt, or hike these maps are an invaluable aid.

Each quadrangle map shows an area of about 60 square miles. There are 805 of these needed to depict the entire Commonwealth. From these can be seen the positions of houses, towns, highways, trails, lakes, mountains, and wooded areas. Most features are named. The configuration of the land is indicated by brown, numbered contour lines. From these can be determined the height of each mountain, the depth of valleys, and the approximate elevation and slope of the ground at any place. Distances between points can be determined, as 1 inch on the map represents 2000 feet on the land surface being portrayed.

The outdoorsman can use topographic maps to plan how to reach favorable hunting sites and fishing lakes. Though maps cannot pinpoint where game is present, they do indicate covered woodlands and isolated meadows where deer, turkey, and other game animals are usually found. The bottom configuration of some lakes and reservoirs is shown on these maps, which aids in locating inundated stream channels and former wooded areas and buildings where fish are commonly present. The indication of major trails and shelters together with the position of springs can be used by hikers.

Historical and natural features shown on the maps can be used to plan vacations, especially those who want to get away from the "beaten path." Most State and Federal parks, forests, game management areas, and wildlife refuges are outlined with the positions of camping and picnic areas spotted. Access to outstanding natural features such as Natural Bridge, Endless Caverns, and Great Dismal Swamp can be determined. The locations of military parks and cemeteries as well as the birthplace of famous men such as George Washington are indicated.

These topographic maps can be obtained in person or by mail for $0.75 *each (plus 4 percent tax for maps mailed to Virginia addresses)* from the Virginia Division of Mineral Resources, Box 3667, Charlottesville, Va. 29903. Prepayment by cash, money order, or check is required; make checks to the order of the Division. An index of available quadrangle maps is free on request. To aid in ordering, the following lists contain the number of maps needed and their total price for various features of interest to vacationers. Feature boundaries are those depicted on maps available January 1, 1973 (*indicates neither outline boundaries nor name shown on map). *Please do not forget to enclose 4 percent sales tax in addition to the total price if a Virginia addressee.*

State Forest	*No.*	*Total Price*
Buckingham-Appomattox	4	$ 3.00
Conway-Robinson	1	0.75
Cumberland	4	3.00
Lee Experimental	2	1.50
*Lesesne	1	0.75
Paul	1	0.75
Pocahontas	2	1.50
Prince Edward-Gallion	1	0.75
*Whitney	1	0.75
State Game Management Area		
*Amelia	1	0.75
*Apple Manor	2	1.50
*Chickahominy River	1	0.75
*Clinch Mtn.	3	2.25
*Elm Hill	1	0.75
*Fairystone	4	3.00
*Fisherman Island	1	0.75
*Gathright	3	2.25
Goshen	2	1.50
*Hardware River	2	1.50
Havens	2	1.50
*Hidden Valley	2	1.50
Highland	4	3.00
Hog Island	1	0.75
*James River	1	0.75
*Lands End	1	0.75
*Little North Mtn.	5	3.75
*Mockhorn Island	4	3.00
*Pocahontas Waterfowl Area	1	0.75
Powhatan	2	1.50
*Rapidan	4	3.00
*Saxis	2	1.50
*Trojan Waterfowl Area	1	0.75
*Weston	1	0.75
*White Oak Mtn.	1	0.75
*Wreck & Bone Island Natural Area	1	0.75
*Wunder	1	0.75

State Park	*No.*	*Total Price*
*Barbours Hill	1	$ 0.75
*Bear Creek Lake State Park	1	0.75
Breaks Interstate Park	1	0.75
*Charles C. Stierly Heron Rookery	1	0.75
Chippokes Plantation	1	0.75
Claytor Lake State Park	2	1.50
Douthat State Park	1	0.75
Fairy Stone State Park	2	1.50
*Goodwin Lake State Park	1	0.75
*Goshen Pass Natural Area	1	0.75
Grist Mill Historical Park	1	0.75
*Holliday Lake State Park	1	0.75
Hungry Mother State Park	2	1.50
*Lick Creek Natural Area	2	1.50
*Mollys Knob Natural Area	2	1.50
*Mount Rogers State Park	3	2.25
*Natural Tunnel State Park	1	0.75
Occoneechee State Park	2	1.50
*Parkers Marsh Natural Area	1	0.75
Pocahontas State Park	2	1.50
*Prince Edward State Park	1	0.75
Sayler's Creek Battlefield Park	1	0.75
*Seashore Natural Area	1	0.75
Seashore State Park	1	0.75
*Shot Tower Historical Park	1	0.75
Southwest Virginia Museum	1	0.75
Staunton River State Park	1	0.75
Westmoreland State Park	2	1.50
*Wreck Island Natural Area	1	0.75
National Forest		
George Washington	84	63.00
Jefferson	99	74.25
*Mount Rogers National Recreation Area	14	10.50
National Park		
Appomattox Court House National Historical Park	1	0.75
Assateague Island National Seashore	3	2.25
Blue Ridge Parkway	30	22.50
Booker T. Washington National Monument	1	0.75
Colonial National Historical Park and Parkway	6	4.50
Cumberland Gap National Historical Park	5	3.75
Fredericksburg & Spotsylvania National Military Park	7	5.25
Fredericksburg National Cemetary	1	0.75
George Washington Birthplace National Monument	1	0.75
Manassas National Battlefield Park	1	0.75
Petersburg National Military Park	2	1.50
Poplar Grove National Cemetary	1	0.75
Richmond National Battlefield Park	5	3.75
Shenandoah National Park	34	25.50
Yorktown National Cemetary	1	0.75
National Wildlife Refuge		
Back Bay	2	$ 1.50
Chincoteague	4	3.00
*Fisherman Island	1	0.75
*Mackay Island	1	0.75
Presque Isle	4	3.00
Trail		
Appalachian	64	48.00

Fishing Lake, Pond, Reservoir—Feature boundaries are those depicted on maps available January 1, 1973 (*indicates feature not named on map). Those water features with bottom topography indicated are designated as (b). Name variations are shown in parentheses. Where features are located across county boundaries the number of maps listed is for entire depiction.

County/City	*No.*	*Total Price*
Albemarle		
Albemarle Lake	1	.75
*Beaver Creek Lake	1	.75
Reynovia Lake	1	.75
Alleghany		
*Clifton Forge Reservoir	1	.75
*Pike Pond	1	.75
Amelia		
*Amelia Lake	1	.75
Beaver Pond	1	.75
Chesdin Lake (b)	3	2.25
Jones Lake	1	.75
Amherst		
Lynchburg Reservoir (Pedlar Lake)	1	.75
Appomattox		
Holliday Lake	1	.75
Augusta		
Braley Pond	1	.75
Elkhorn Lake	1	.75
Hearthstone Lake	1	.75
Puffenbarger Pond	1	.75
Sherando Lake	1	.75
*Upper Sherando Lake	1	.75
Bath		
Douthat Lake	1	.75
Bedford		
Bedford Lake	1	.75
Leesville Lake	4	3.00
*Peaks of Otter Lake	1	.75
Smith Mtn. Lake (b)	6	4.50
Botetourt		
Carvin Cove Reservoir	2	1.50
Brunswick		
County Pond (Brunswick Lake)	1	.75
Gaston Lake (b)	5	3.75
Nottoway Reservoir	2	1.50
Buckingham		
Holliday Lake	1	.75
Horsepen Lake	1	.75
Campbell		
Leesville Lake	4	3.00
Carolina		
Bowies Pond	2	1.50
Delos Lake	1	.75
Herns Pond	1	.75
Lonesome Gulch Pond	1	.75
Millers Pond	1	.75
Smoots Pond	1	.75
Travis Lake	1	.75
White Lake	1	.75
Carroll		
*Byllsbee Reservoir	1	.75
Charles City		
Harrison Lake	1	.75
Charlotte		
John H. Kerr Reservoir	15	11.25
Chesapeake City		
Drummond Lake	1	.75
Chesterfield		
Chesdin Lake (b)	3	2.25
*Falling Creek Reservoir	1	.75
*Lakeview Dam	1	.75
Third Branch Lake (Beaver Lake)	1	.75
Swift Creek Lake	1	.75
Swift Creek Reservoir (b)	1	.75
Culpepper		
Caynor Lake	2	1.50
Merrimac Lake	1	.75
Mountain Run Lake	1	.75
Cumberland		
Arrowhead Lake	1	.75
Bear Creek Lake	1	.75
Bonbrook Lake	1	.75
Oak Hill Lake	1	.75

County/City	No.	Total Price
Winston Lake	1	.75
Dickinson		
Flannagan Reservoir (b)	2	1.50
Dinwiddie		
Chesdin Lake (b)	3	2.25
Colemans Lake	1	.75
Hobbs Millpond	1	.75
Tommeheton Lake	1	.75
Twin Lakes	1	.75
Wheelers Pond	1	.75
Fairfax		
Burke Lake (b)	1	.75
Fairfax Lake	1	.75
Occoquan Reservoir	3	2.25
Fauquier		
Brittle Lake	2	1.50
Dalton Pond	1	.75
Fluvanna		
Fluvanna-Ruritan Lake	2	1.50
Franklin		
Philpott Reservoir	2	1.50
Smith Mtn. Lake (b)	6	4.50
Giles		
Mountain Lake	1	.75
Gloucester		
Haynes Pond	1	.75
Grayson		
Hale Lake	1	.75
Greensville		
*Emporia Reservoir	1	.75
Garners Mill Pond	1	.75
Rainey Pond	1	.75
Slagles Lake	2	1.50
Smith Pond	1	.75
Taylors Mill Pond	1	.75
Halifax		
Banister Lake (Halifax Reservoir)	1	.75
Conner Lake	1	.75
John H. Kerr Reservoir	15	11.25
Hanover		
Fleming Millpond (Woodsons Pond)	1	.75
Fulcher Millpond	1	.75
Parsleys Millpond (Beatties Millpond)	1	.75
Henry		
Martinsville Reservoir	3	2.25
Philpott Reservoir	2	1.50
Isle of Wight		
Burnt Mills Lake	1	.75
*Smithfield Water Works	1	.75
James City		
Diascund Reservoir	2	1.50
Powells Lake	2	1.50
King and Queen		
Mitchell Millpond	1	.75
Louisa		
Izac Lake	1	.75
Louisa Lake	1	.75
Lunenburg		
Victoria Lake	1	.75
*Va. R.R. Falls Pond	1	.75
Lynchburg City		
College Lake	1	.75
Mecklenburg		
Gaston Lake (b)	5	3.75
Gordon Lake	1	.75
John H. Kerr Reservoir	15	11.25
Nansemond City		
Burnt Mills Lake	1	.75
Cohoon Lake	2	1.50
Kilby Lake	2	1.50
Meade Lake	3	2.25
Prince Lake	2	1.50
Western Branch Reservoir (Lake Western Branch)	2	1.50
Nelson		
Nelson Lake	1	.75
New Kent		
Diascund Reservoir	2	1.50
Newport News		
City Reservoir (Lee Hall Reservoir)	1	.75
Norfolk City		
Whithurst Lake	1	.75
Northumberland		
Gardy Millpond	2	1.50
Nottoway		
Birchin Lake	1	.75
Crystal Lake (Nottoway Pond)	2	1.50
*Nottoway Reservoir	2	1.50
Orange		
Orange Lake	1	.75
Patrick		
Fairystone Park Lake	1	.75
Philpott Reservoir	2	1.50
Smith Mountain Lake	6	4.50
Pittsylvania		
Burton Lake	1	.75
Leesville Lake	4	3.00
Powhatan		
Bass Pond	1	.75
*Bream Pond	1	.75
Bullhead Pond	1	.75
Powhatan Lakes	2	1.50
Sunfish Pond	1	.75
Prince Edward		
Goodwin Lake	1	.75
Prince Edward Lake	1	.75
Prince George		
Binford Lake	1	.75
Izaak Walton Road (Baxters Pond)	1	.75
Prince William		
Breckenridge Reservoir	1	.75
Camp Upshur Pond	1	.75
Jackson Lake	1	.75
Occoquan Reservoir	3	2.25
Pulaski		
Clayton Lake	3	2.25
Gatewood Reservoir	2	1.50
Richmond City		
Youngs Pond (Bryan Park Lake)	1	.75
Roanoke		
Carvin Cove Reservoir	2	1.50
Rockingham		
Shenandoah Lake	1	.75
Russell		
Bonaventure Lake	1	.75
*Laurel Bed Lake (b)	1	.75
Scott		
Corder Bottom Lake (Scott-Wise Lake)	1	.75
Shenandoah		
Tomahawk Pond	1	.75
Smyth		
Hungry Mother Lake	2	1.50
Southampton		
Windbourne Mill Road	1	.75
Spotsylvania		
*Embry Reservoir	1	.75
Stafford		
*Barrett Pond	1	.75
Breckenridge Reservoir	1	.75
Lunga Reservoir	1	.75
R-6 Pond	1	.75
Surry		
Sunken Meadow Pond	1	.75
Sussex		
Airfield Pond	1	.75
Nebletts Millpond (Game Refuge Pond)	1	.75

County/City	*No.*	*Total Price*
Va. Beach City		
Lawson Lake	1	.75
Little Creek Reservoir	1	.75
Smith Lake	2	1.50
Washington		
*Hidden Valley Lake (b)	1	.75
South Holston Lake	3	2.25
Westmoreland		
Chandlers Mill Pond	1	.75
Wise		
*High Knob Lake	1	.75
York		
Howards Mill Reservoir	1	.75

NEW PUBLICATIONS

Mineral Resources Report 10. DEVELOPMENT OF GROUND-WATER SUPPLIES IN SHENANDOAH NATIONAL PARK, VIRGINIA, by Richard H. DeKay; 158 p., 31 figs., 2 tables. Price $2.00 (plus 4 percent State sales tax).

Shenandoah National Park encompasses more than 300 square miles in portions of eight counties located in the Blue Ridge Mountains of northwestern Virginia. Thirteen geologic formations comprise the bedrock of these mountains and their foothills, eight of which occur on the lower west slopes and one on the lower east slope. The other four rock units underlie the upper portion of the eastern slope and the mountain crest; these formations are of late Precambrian and early Cambrian age, and are comprised of basaltic, granitic, and clastic sedimentary rocks. Existing public facilities in the Park are located on these impermeable rocks near the crest of the mountains, and water supplies are premium requirements.

Springs furnished water to all Park facilities from its inauguration in 1936 until 1961, but expansion of facilities had greatly increased the water demand. Efforts were made to recondition existing springs and to locate additional ones for development, but the former was unsuccessful and the latter either too far from areas of water consumption or unreliable during the summer months. From 1961 to 1971 the Virginia Division of Mineral Resources located test-hole drilling sites in predesignated areas along the mountain crest, and preliminary data indicate 20 of the 33 test holes drilled for water can be converted into wells with yields that exceed the summer flows of developed springs.

Mineral Resources Report 11. HIGH-SILICA RESOURCES OF CLARKE, FREDERICK, PAGE, ROCKINGHAM, SHENANDOAH, AND WARREN COUNTIES, VIRGINIA, by W. Burleigh Harris; 42 p., 1 map, 17 figs., 11 tables. Price $0.75 (plus 4 percent State sales tax).

The principal high-silica resources of Clarke, Frederick, Page, Rockingham, Shenandoah, and Warren counties in the northern Valley and Ridge province of Virginia are in the Erwin Formation, Tuscarora Formation, Massanutten Sandstone, Ridgeley Sandstone, and Pocono Formation. Physical descriptions, sieve analyses, and chemical test data are presented for evaluation of potentially commercial high-silica raw material.

Composite samples from selected localities in the Erwin, Tuscarora, and Ridgeley, analyzed in a raw or unbeneficiated condition, have a silica content that ranges from 96.8 to 99.7 percent. The percentage of silica in beneficiated samples ranges from 98.6 to 99.7. A general decrease in percentage of Al_2O_3 and Fe_2O_3 upon simple beneficiation indicates that some clay- and silt-size particles and some iron-oxide stains on the quartz grains were effectively removed. Histograms and cumulative-frequency curves provide a visual guide to grain-size distribution, average grain size, and the degree of sorting. Chemical analyses of hand samples of the Erwin, Tuscarora, Massanutten, and Pocono indicate a silica content that ranges from 98.6 to 99.6 percent; sieve analyses were not performed because of the high degree of induration of these samples.

Report of Investigations 31. GEOCHEMICAL RECONNAISSANCE FOR ZINC, LEAD, AND COPPER IN THE STAUNTON QUADRANGLE, VIRGINIA, by Richard S. Good and Gary C. Allen; 47 p., 25 figs., 7 tables. Price $1.00 (plus 4 percent State sales tax).

Atomic-absorption analyses were made on soils collected on a quarter-mile rectangular grid in the Staunton 7.5-minute topographic quadrangle. These were evaluated by comparison with quarter-

and eighth-mile grids around known zinc mineralization in the nearby geologically similar Timberville area of the Shenandoah Valley. The areas of investigation are underlain by folded and fractured Upper Cambrian to Middle Ordovician sedimentary rocks, which are dominantly carbonates.

The data were evaluated by using histograms and probability curves for each geologic formation, and by using a floating mean ALGOL-trend surface program for the entire quadrangle. Soils overlying the Beekmantown Formation (Lower Ordovician) averaged 54 ppm and the distribution was markedly asymmetrical indicating an anomalous population. From probability curves, 180 ppm was determined as a threshold for reconnaissance sampling. Anomalous values were determined in an area north of Franks Mill in the northwestern part of the quadrangle, where sphalerite and fluorite are present on strike just outside the quadrangle. Weak anomalies of zinc and lead occur in other parts of the area. Copper can be used to delineate the presence of zinc and lead.

1972 UNITED STATES ENERGY POSITION[1, 2]

WORLD ENERGY DEMAND

Mankind has used more energy in the last 30 years than he consumed in all history prior to 1940. The zenith has yet to be reached. World energy consumption is expected to nearly double between 1970 and 1980, increasing from the equivalent of 87 million barrels of crude oil per day to 160 million barrels. By the year 2000, world energy demand—spurred by the development of the less industrialized nations—is projected to increase nearly fivefold, reaching the equivalent of 400 million barrels daily. The average annual increase during this 30-year period is predicted at 5.2 percent, with the most dramatic increase coming in the current decade when the annual growth is expected to be 6.3 percent.

The United States—already the leading energy user—will maintain its leadership; but the most significant gain is expected to be made by Japan, which will probably more than double its consumption in this decade alone. Japan's consumption in 1970 was the equivalent of 6 million barrels of crude oil per day but is estimated at 14 million barrels by 1980.

UNITED STATES ENERGY DEMAND

The United States—with one-sixteenth of the world's population—consumes one-third of the world's energy. We heat and cool more homes, travel more miles, and produce more goods than any other nation. Energy cooks our food, lights our way, and runs our machines.

Energy consumption doubled in the last 20 years. The demand is expected to double again in the 15 years between 1970 and 1985, increasing from the equivalent of 31.8 million barrels of crude oil daily to 62 million barrels. During this period, the annual average growth rate is predicted to be 4.3 percent. This increased demand is not at government dictate. Nor is it determined by industry. Society itself makes the demand and sets the pattern for growth.

The nation's energy is primarily used by four major markets: transportation, residential, industrial, and electric utilities. These four markets today consume 82 percent of the nation's energy.

Transportation.—The prospect is that this will

[1]Reprinted from portions of a booklet, **The National Energy Position**, published and distributed by Shell Oil Company, Houston, Texas, 1972.

[2]Throughout this article, crude oil equivalent is used as the yardstick for energy. This is an appropriate indicator since 96 percent of the energy used in the United States today comes from fossil fuels: oil, natural gas, and coal.

continue to be a highly mobile society and, therefore, transportation will continue to be a major energy consumer. Registration of vehicles is expected to increase from 111 million today to 155 million in 1985. The continued trend toward multiple car families, spread out metropolitan areas, younger drivers, and circular traffic patterns around major cities is expected to result in the average car being driven more miles in 1985, increasing from 9800 miles in 1970 to 11,000. These factors lead to the forecast that gasoline consumption will almost double between 1970 and 1985, jumping from 5.8 million barrels per day to 9.6 million barrels.

Although there will be volumetric increases in gasoline consumption, its share of the market is expected to diminish slightly in the next 15 years. Gasoline accounted for 71 percent of the total transportation market in 1970 but will drop to 65 percent in 1985 because of gains made by jet fuel, which will increase from 13 percent to 19 percent during the same 15-year period.

Electric Utilities.—Electricity is an elegant form of energy. It is, however, really a secondary fuel since it must first be generated by some basic energy resource such as oil, coal, hydroelectric, or nuclear power.

Electricity, discounting conversion and line losses, is efficient and causes no pollution problems for the consumer. It is delivered continuously and automatically. For these reasons, industry has turned increasingly to electricity and by 1985 is estimated to use 40 percent of the nation's electric power. Additionally, 14 million all-electric homes are expected to be built in the next 15 years, nearly three times as many as existed in 1970. The residential market will consume 30 percent of the nation's electricity by 1985.

This increased demand for electricity has caused the utilities market to grow rapidly. In the 15 years between 1970 and 1985, the electric utilities market will show an average annual increase of about 7 percent. By 1985 it will be the largest energy market, increasing from the equivalent of eight million barrels of crude oil per day in 1970 to 23 million barrels.

Industry.—Industry will show a more modest growth in energy consumption than will other users. The average annual growth rate is expected to be about 3 percent, significantly below the 4.4 percent expected for energy consumption as a whole. This is not an indication of a slowdown in industrial growth, but rather, is the result of increased efficiency in fuel utilization. This will be made possible as more industrial users switch from oil and coal to electricity as their primary energy supply. In the years between 1970 and 1985, the industrial market's use of energy is expected to increase slightly more than 50 percent.

Residential.—Several factors—particularly population and disposable income—will influence the residential market. Population is expected to increase by about 36 million between 1970 and 1985 and it is projected that nearly 40 million new housing units will be needed.

The generally increasing affluence of our society will also have a direct effect on residential energy requirements. More and more families, for example, will consider air conditioning a necessity rather than a luxury and will be willing and able to pay for it. These factors will result in the residential demand increasing from the equivalent of 5.1 million barrels in 1970 to 8.4 million barrels daily in 1985. This will be an annual average increase of 3.4 percent.

Electricity will be the fastest growing source of residential energy although natural gas—holding at 46 percent of the market—will remain the leader. Electricity, which had 14 percent of the market in 1970, will increase its share to 25 percent by 1985.

UNITED STATES ENERGY SUPPLY

The lag in the development of nuclear power means that oil and natural gas will still provide 72 percent of the country's energy needs in 1980. As late as 1985, their share of the total market will be 66 percent. However, our reserves of these two most important fuels are diminishing. Therefore, it now appears inevitable that the United States—which already depends on foreign sources for 25 percent of its petroleum needs—will become increasingly reliant on imports. On the basis of current supply and demand estimates, it is now expected that by 1985 imports will account for 66 percent of the country's oil needs.

Seven sources of energy are expected to supply United States needs between now and 1985. Four of these—oil, natural gas, coal, and hydroelectric power—are veteran contributors. The remaining three—nuclear, tar sands, and shale oil—are relative newcomers to the market.

Natural Gas.—Natural gas currently provides one-third of the nation's energy. There are two reasons for its importance. First, it is an extremely clean fuel. Secondly, it has been a relatively inexpensive fuel. In each of the last three years, however, United States gas consumption has exceeded the amount of new reserves found. Production reached an all-time high in 1970, but is expected to peak at around 22 trillion cubic feet in 1975 and then steadily decline to less than 18 trillion cubic feet by 1985.

The declining production of natural gas will be supported to some degree by the arrival in the late 1970's of Alaskan gas, continuing but diminishing Canadian imports, gas derived from coal, and imported liquefied natural gas. Together, these supplementary sources will contribute approximately 7 trillion cubic feet per year in 1985.

Oil.—Steadily increasing demands coupled with reduced natural gas supplies, coal's environmental drawbacks, and the delays in nuclear power have created an energy gap which can only be filled by oil.

Crude oil is our most important source of energy. In 1970, oil accounted for 43 percent of the nation's energy, with consumption at 13 million barrels per day. During this decade oil will continue to increase its share of the market until in 1980 it contributes 46 percent of the country's energy, with the demand at nearly 24 million barrels daily. Though oil's share of the market will drop back to 43 percent in 1985 as nuclear energy gains influence, the volumetric demand will increase to an estimated 29 million barrels per day.

Domestic production will not be able to meet these demands. It is now estimated that United States oil production will, within the next two years, peak at about 11 million barrels daily. This is a new position for the United States. As recently as 1957 our proved reserves—oil recoverable under existing economic and operating conditions —were 12.5 times annual production. During the 1960's, proved reserves declined while the demand rose. Today, our reserves are down to about nine times annual production and continue to sink. Even the much-heralded Alaskan North Slope discoveries—which cannot yet reach the lower 48 states—add only about a three-year supply to our reserve under current consumption rates. At its peak, in 1980, Alaskan North Slope crude is expected to provide approximately 2 million barrels daily. The remainder of the United States oil supply will come from increasing amounts of foreign crude oil, foreign products, Canadian crude, and, beginning about 1977, synthetic oil from shale.

The petroleum supply situation just discussed will bring about some dramatic changes in the distribution of the world's oil supplies. In 1970, the United States was fairly self-sufficient. There were small movements of crude oil from Canada. South America—primarily Venezuela—contributed the largest external supply, 2.3 million barrels daily. Most of this was residual heating oil for the East Coast. The Middle East provided only about 600,000 barrels daily. Western Europe and the Asian Pacific were the major users of Middle East imports.

In just eight years, a considerable change is forecast. The Alaskan North Slope crude is expected to reach 2 million barrels per day. Canadian crude will contribute another 2 million barrels. Crude movements from South America will expand to 4 million barrels daily and more would be imported if it were available. The most significant increase, however, will be the amount of Middle East crude imported. Imports from that source are expected to increase tenfold, reaching 6.5 million barrels daily.

The United States will soon be obliged to compete in the world market for a major share of its petroleum. Western Europe's imports of Middle East crude are expected to double by 1980. Imports from the Middle East to the Asian Pacific will triple during the same period.

Coal.—Coal, the nation's most abundant source of fossil fuels (it is estimated that we have a several hundred year potential supply at present consumption rates), is predicted to show a slight decrease in its share of the energy market during

the next 13 years.

It today provides 19.4 percent of the nation's energy needs, with 1970 production listed at the equivalent of 6.2 million barrels per day. While the total volume of coal production is expected to reach 11.9 million barrels per day in 1985, its percentage of the overall energy market will drop to 19.1 percent.

There are several reasons for coal's slip. Faced in the 1960's with the prospect of nuclear energy rendering its product obsolete and with competition from low-priced natural gas and imported residual fuel, the coal industry failed to grow with energy demands. Few new mines were opened and little was done to expand older mines.

The development of low-sulfur coal deposits in the Western United States during the late 1970's, the use of coal as the base for synthetic fuel production, and the advent of a process to remove pollutants from smokestacks will be factors in the coal industry realizing an increase in energy importance in the middle and late 1980's.

Hydropower.—Hydropower, which is limited by the number of available natural sites, will remain a constant factor in the energy picture. It currently provides about 3 percent of the nation's energy and will decline slightly from that level during the next 15 years.

Nuclear Power.—Nuclear power was seen in the 1960's as the key to the United States' energy future. That hope still exists, but the arrival of nuclear energy to the market place has been delayed. Construction costs of facilities had been underestimated. Nuclear power, however, is gradually increasing its share of the energy market. In 1970, it provided less than one percent of the country's total energy, but by 1985 it is expected to contribute 14 percent. The distribution of nuclear facilities will generally be geographically uniform except in the Rocky Mountain areas where competitive fossil fuel supplies will continue to dominate the electricity utility market.

Shale Oil.—Shale oil, because of economics and technology, is expected to be the first liquid synthetic fuel produced in the United States. The major area of oil shale reserves is located in the Piceance Basin of Colorado, estimated to contain almost 80 billion barrels of recoverable oil. It is anticipated that the first commercial units will be in operation by 1977. Even by 1985, however, shale oil will play a relatively minor role in the total energy picture. Production in 1985 is estimated at about 500,000 barrels of crude oil daily.

Tar Sands.—There are no significant tar sands deposits in the United States. The Athabasca Tar Sands in Canada, however, contain large quantities of potentially recoverable oil. Although the necessary technology exists, economics currently make oil from tar sands generally unattractive. Before the end of the forecast period, however, it is expected that oil from tar sands will become competitive. However, any large scale development will require considerable lead time. Bearing this in mind, and Canada's own growing energy needs, it now appears that tar sands will not play a major role in the United States energy picture before 1980. After that date, however, this unconventional fuel will have a substantial impact on Canadian crude production and will, in effect, provide greater latitude in the amount of oil available for import into the United States.

1972 UNITED STATES ENERGY USE[1]

The United States used more energy in 1972 than ever before, and the rate of increase doubled over 1971. Preliminary estimates have indicated that the United States 1972 demands for heat, light, and power in all forms required energy equivalent to 72,091 trillion British thermal units (Btu). This was a 4.9 percent increase over 1971, and more than double the 2.4 percent rise from

[1]Prepared by Division of Fossil Fuels, U. S. Bureau of Mines, 1973.

Table 1.—Apparent consumption of primary energy resources and related products.

Commodity	1971	Preliminary 1972	Percentage change from 1971
Primary energy sources:			
Bituminous coal and lignite ..... million short tons	494.9	511.2	+3.3
Anthracite ..... do	7.3	5.8	−20.1
Crude petroleum, runs to stills ..... million barrels	4,087.8	4,270.7	+4.5
Natural gas[1] ..... billion cubic feet	22,132.5	22,607.0	+2.1
Natural gas liquids[2] ..... million barrels	617.8	633.5	+2.5
Hydropower, utility[3] ..... million kilowatt-hours	269,850.6	276,828.0	+2.6
Hydropower, industrial[4] ..... do	3,259.9	3,413.0	+4.7
Nuclear power, utility[4] ..... do	37,899.2	56,850.0	+50.0
Products:			
All oils, domestic product demand[5] ..... million barrels	5,552.6	5,960.1	+7.3
Coke ..... million short tons	56.7	58.9	+3.9
Electricity, conventional fuel-burning plants:			
Utility[4] ..... million kilowatt-hours	1,309,716.2	1,405,000.0	+7.3
Industrial[4] ..... do	100,324.8	103,500.0	+3.2

[1] Residue gas—excludes extraction loss but includes transmission loss.

[2] Liquids recovered from natural gas processing plants.

[3] Net generation, adjusted for net imports or exports. The net trade is hydropower with an undetermined portion of steam plant power.

[4] Net generation.

[5] Includes natural gas liquids.

Source: Division of Fossil Fuels, U. S. Bureau of Mines.

1970 to 1971. Total energy demand in 1972 was met by a combination of increased imports of natural gas, crude oil, and petroleum products, and increased domestic production of all fossil fuels except Pennsylvania anthracite.

Net imports of all fuels increased 24.5 percent over 1971, and energy produced from imported fuels accounted for 12.5 percent of total energy consumption. Reacting to temporary relaxation of import restrictions, the United States imported 798.2 million barrels of crude oil, a 30.1 percent jump over 1971. Imports of petroleum products totaled 916.8 million barrels, up 11.9 percent, and imports of natural gas totaled 1,032 trillion cubic feet, up 10.4 percent over 1971.

In the United States, production of bituminous coal and lignite was approximately 590 million short tons, up 6.8 percent from 1971. Crude oil output was almost 3.5 million barrels in 1972, only a .2 percent increase, and natural gas output was slightly more than 22.9 trillion cubic feet, a 1.9 percent increase over last year. Nuclear power generation increased 50 percent to 56.9 billion kilowatt-hours. Utility hydropower generation increased nearly three percent to 276.8 billion kilowatt-hours.

Electric utilities last year used 7.1 percent more energy for power generation than in 1971. (Energy "lost" in converting fuels to electricity amounted to 12.5 trillion Btu.) Transportation energy needs grew 5.7 percent, household and commercial uses increased 4.2 percent, and industrial uses were up 4 percent.

Petroleum (including natural gas liquids) supplied 46 percent of all domestic energy needs. Natural gas was next, supplying 32 percent, fol-

Table 2.—U. S. net trade,[1] mineral fuels.

	Exports		Imports		Net Trade		Percentage change from 1971
	Quantity[2]	Trillion Btu	Quantity[2]	Trillion Btu	Quantity[2]	Trillion Btu	
Anthracite:							
1971	−1,389.0	−35.3	—	—	−1,389.0	−35.3	
1972 (preliminary)	−1,247.0	−31.7	—	—	−1,247.0	−31.7	−10.2
Bituminous coal & lignite:							
1971	−56,633.0	−1,534.5	111.0	2.8	−56,522.0	−1,531.7	
1972 (preliminary)	−57,000.0	−1,514.3	200.0	5.3	−56,800.0	−1,509.0	+0.5
Natural gas, dry[3]:							
1971	−80,212.0	−82.7	934,548.0	963.5	854,336.0	880.8	
1972 (preliminary)	−80,000.0	−82.5	1,032,000.0	1,064.0	952,000.0	981.5	+11.4
Petroleum (crude):							
1971	−0.5	−2.8	613.4	3,431.4	612.9	3,428.6	
1972 (preliminary)	−0.2	−1.1	798.2	4,480.1	798.0	4,479.0	+30.2
Petroleum products[4]:							
1971	−81.3	−466.1	819.5	4,974.2	738.2	4,508.1	
1972 (preliminary)	−79.7	−456.9	916.8	5,564.7	837.1	5,107.8	+13.4
Total mineral fuels:							
1971	xx	−2,121.4	xx	9,371.9	xx	7,250.5	
1972 (preliminary)	xx	−2,086.5	xx	11,114.1	xx	9,027.6	+24.5

xx Not applicable.

[1] Minus sign indicates exports.
[2] Quantities used are: Anthracite and bituminous coal and lignite, thousand short tons; natural gas, million cubic feet; and petroleum (crude and products) million barrels.
[3] Excludes natural gas liquids.
[4] Includes natural gas liquids.
Source: U. S. Bureau of Mines.

lowed by bituminous coal (17 percent), hydropower (4 percent), nuclear power (0.8 percent), and anthracite (0.2 percent).

Coal remained the major fuel for generating electric power, but its share of that market dropped from 52 percent in 1971 to 51 percent last year. Total demand for bituminous coal and lignite rose 3.3 percent to 511.2 million tons, with electric utilities accounting for 65.6 percent of all coal consumed in 1972.

Threatened shortages of natural gas caused many industrial users to convert to other fuels, resulting in a modest 2.1 percent increase in natural gas demand in 1972 compared with a 3.6 percent rise in 1971.

Demand for petroleum and natural gas liquids rose 7.3 percent to almost six billion barrels. Demand for fuel oils in electricity generation increased 26.5 percent to 515 million barrels while demand in the transportation sector, largest market for petroleum, increased 5.8 percent to 3.2 billion barrels.

Table 1 shows preliminary 1972 consumption of energy resources; Table 2 shows net trade in mineral fuels for the years 1971-72.

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NEW ADDRESS FOR ROCK AND MINERAL EXCHANGE

The following notice appeared in the February 1973 issue of the Council on Education in Geological Sciences *Newsletter* and is here reprinted to inform teachers of the continued availability of a means to procure rock and mineral specimens.

"Science teachers interested in exchanging rocks, minerals, fossils, and/or earth science curriculum materials are asked to send a list (with size and quantity) of the materials they *need* and a list (with size and quantity) of the materials they can *trade* to the Rock and Mineral Exchange Service (RMES). RMES will then supply names, addresses, and "swap sheets" of those teachers interested in exchanging materials on a swap basis. Due to the free, voluntary nature of RMES, only those inquiries accompanied by stamped, self-addressed envelopes will be processed. Write: Charles and Janet Wall, RMES, Department of Science Education, The University of Georgia, Athens, GA 30601."

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TOPOGRAPHIC MAPS

7.5-MINUTE QUADRANGLE MAPS

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▒ Map updating in progress

■ Updated maps published from January 1, 1973 through March 31, 1973:

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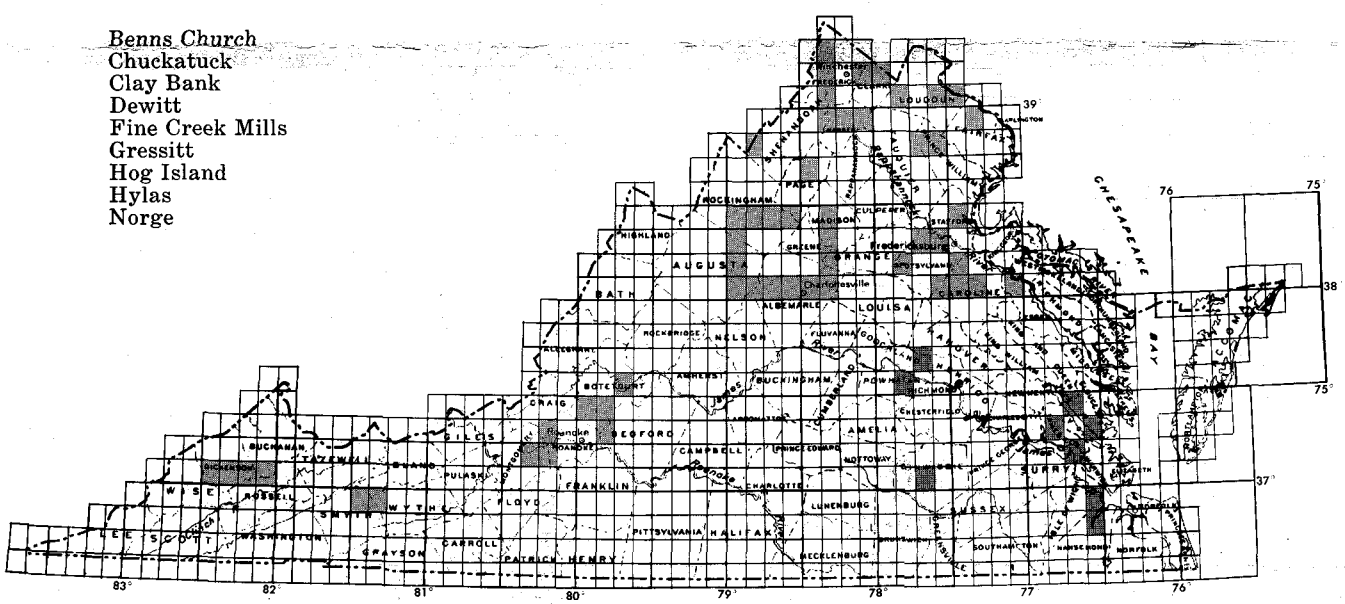
Chuckatuck
Clay Bank
Dewitt
Fine Creek Mills
Gressitt
Hog Island
Hylas
Norge



PUBLISHED MAPS

State index is available free. Updated maps, on which recent cultural changes are indicated, are now available for certain areas of industrial, residential, or commercial growth. Published maps are available at 75 cents each (plus 4 percent state sales tax for Virginia residents) from the Virginia Division of Mineral Resources, Box 3667, Charlottesville, VA 22903.