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DEVELOPED AND POTENTIAL WATER POWER OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD DECEMBER 1952

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Douglas McKay, Secretary

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W. E. Wrather, Director

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DEVELOPED AND POTENTIAL WATER POWER OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD, DECEMBER 1952

By Benjamin E. Jones and Loyd L. Young

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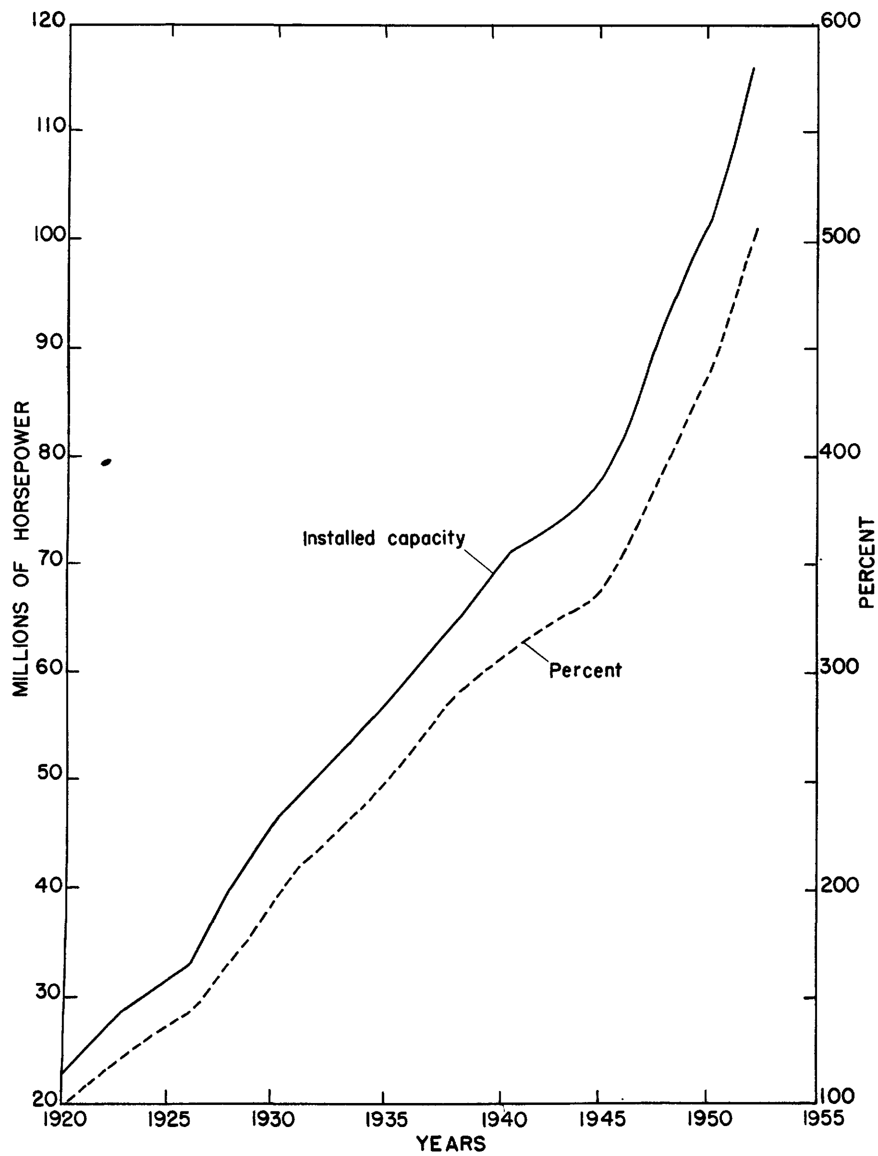

Figure 1. Increase in water-power installations of the world, 1920-52.

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INTRODUCTION

This circular has been prepared to show, as far as the available data will permit, the total water-power resources of the United States and the other countries of the world and the extent to which these resources have been developed. The distribution of the developed and potential water power throughout the world is shown by the listing of estimates of the respective countries by continents in table 2.

The potential water power of the United States was first estimated by the Geological Survey in 1908. These estimates have been revised at intervals since that time and were last released in 1949. In general the best estimates are for those countries which have the best coverage of basic maps. For the most part these are the western states.

The compilation of potential and developed water power for the entire world was first made in 1918 when engineers of the U. S. Geological Survey prepared an estimate of the potential and developed water power of the world, by countries, for use at the Versailles Peace Conference. This estimate was published in 1920 by the Department of the Interior in World Atlas of Commercial Geology, Part II, Water Power of the World. Since that time the estimates, entitled Developed and Potential Water Power of the World, have been kept up to date and released as mimeographed pamphlets at intervals of 2 to 3 years.

DISCUSSION

In preparing the original estimates of the developed and potential water power of the world the estimates published by the various countries were used wherever available. However, there were many areas where studies of potential power had not been made. For these areas the probable potential power was determined from existing data on rainfall and topography. When these data were later supplanted by estimates prepared in the countries themselves, the two were usually in reasonable agreement.

To keep the estimates of developed water power up to date all available sources have been assembled and evaluated. In recent years this has been done almost entirely by following the water-power developments of the various countries from reports and articles in yearbooks; from publications of the Department of Commerce, the Federal Power Commission, the World Power Conference, the United Nations, the International Union of Producers and Distributors of Electric Energy; and from various engineering and scientific journals appearing in the United States and abroad. There is a great deal of conflicting information on some countries. An effort has been made, however, to select the source that seems to have the best data, and the total of 115,600,000 horsepower for the world at the end of 1952 is reasonably correct.

Figure 1 shows the increase of water-power installations since the first estimates were released. Table 1 shows the total installed capacity as determined for the various releases since 1920 and the percentage of increase over 1920. During the period studied (1920-52) installations estimated at 23,000,000 horsepower were increased 502 percent to 115,600,000 horsepower. The current situation is shown in table 2 where installed capacity, the plant factor, and potential water power available with present flow are given by country and continent. Where available, estimates are also shown of water power represented by the mean flow of a country's streams.

Developed power by countries is based on the installed capacity of water wheels at constructed plants, which averages two to four times and may be as much as ten times the potential power at low flow at the same sites. This fact should be considered in comparing the potential power with the developed power and also in evaluating the percentage of the utilized water-power resources of a nation. For any country a rough estimate of the ultimate installed capacity of water wheels can be obtained by assuming it will equal the power available at mean flow and 100 percent efficiency. For the United States the mean flow is roughly equal to the flow available 25 percent of the time. The sites already utilized may be assumed to be the best sites in a country, except where development is regulated for the purpose of preserving the scenic values, as at Niagara Falls, or for other reasons, or in a large country where the better sites are at long distances from a market.

Table 1 shows an increase in installed capacity of water wheels of 92,600,000 horsepower in the 32 years since 1920, yet the increase is continuing throughout the world. The shortage of fuel, both oil and coal, and the increase in fuel prices makes water power seem more desirable than ever. The trend toward multiple-purpose projects and basin-wide conservation and development of resources has accelerated the rate of water-power installation. New interest, with the resultant increased activity in the development of water-power resources, is almost universal. Plants now under construction in the United States will add roughly 1,850,000 horsepower yearly to the national total for the next 3 years. The largest plants under construction are those on the Columbia and Missouri Rivers. The ultimate capacity of these will total over 7,000,000 horsepower. At one time there was a question as to where to find a market for the power from a large project such as Grand Coulee. Now with wide interconnection the market has outstripped the supply. In other sections of the country the plants under construction are smaller but the total capacity will be large. Canada added over 1,000,000 horsepower to its installed capacity in 1952 and still has plants under construction that will add over 3,000,000 horsepower in initial installations. The ultimate capacity of the sites now being developed will be considerably higher than this. For example, the addition at Niagara Falls and the Kitimat project in British Columbia together will have a total ultimate installation of over 3,000,000 horsepower.

The Union of Soviet Socialist Republics reportedly has 5 plants under construction with an ultimate installed capacity of 6,000,000 horsepower. In other countries the plants are not so large but almost every country is actively constructing new plants and everywhere the power generated can be used as soon as it is available. All the countries of Western Europe, Australia, New Zealand, and Japan, as well as many South American countries, are constructing water-power plants and conducting water-resources studies at an unprecedented rate. Also--and this may be an important milestone in water-resource development--the fabulous sites in Africa are being studied with new interest, several large projects have been undertaken, and some plants of considerable size are actually producing electric current.

The figures for installed capacity of water wheels, although fairly exact in themselves, do not present a complete picture of the utilized water power. In some countries with abundant resources of water power only the better sites are developed, and the machinery installed can be operated to capacity a considerable part of the year. In other countries the installation is such that it can be used to full capacity for perhaps only 25 percent of the year. At other times it can be used to carry the peak load but not continuously.

This condition can be illustrated by the plant factor, which is given where information is available. The plant factor is the ratio of the average load to the aggregate rating of all the generating equipment installed. It will vary somewhat from year to year, depending on the water available and the demand for power. A column headed "Plant factor," has been added to this year's tabulation, and the factor is given for most countries. Where this figure is believed to be based on reliable data it has been shown to one decimal. Where the basic information is not exact, the results are shown in whole numbers. This is a purely arbitrary method adopted to show which figures are based on the best data. In instances where the plant factor seems too high or too low it is possible that information as to output or installed capacity is in error.

For Algeria the plant factor is extremely low, but it is based on reliable figures. On the other hand, although the plant factor given for Canada seems high, actually it may be underestimated as it does not take account of industrial plants, some of which have a very high plant factor. For Argentina the plant factor seems low but it may be that the water-power plants carry mostly peak loads. For Peru it is possible that the reported output does not include some industrial plants, thus reducing the apparent plant factor.

In Europe the high plant factors for Bulgaria, Czechoslovakia, and Hungary may be due to the estimate of installed capacity being low because firsthand information on these countries is not available. Western Germany has large pumped storage plants for peaking purposes, and some of the power for pumping is supplied by steam plants. If the reported output includes power from pumped storage, which is not strictly comparable to the water power produced in other countries, the plant factor for Western Germany would be proportionately higher. For the Union of Soviet Socialist Republics the combined capacity of plants in Europe and Asia was used to obtain the plant factor. Information on the distribution of plants between eastern and western Russia is very limited and the figures are only rough estimates. However, judged by the plant factor, the figure for combined capacity is believed to be reasonably accurate.

The plant factor for Korea is based on the output for 1943 and this indicates that the figure for the installed capacity is reasonably reliable for that time. Although some of the plants have been damaged by war, it is assumed that they can be restored. The plants in Australia are located mainly in Tasmania where the nature of the streams makes a high plant factor possible. Australia is now building new plants with an ultimate capacity of over 1,000,000 horsepower, but they may not have the high plant factor of those now in operation.

Japan and Italy illustrate the importance of the plant factor. Japan not only has a large total installed capacity but a very high plant factor. Italy, with approximately the same total installations, has a low plant factor. Using the average for the years 1950-51 (which may not represent the average year), Japan produced roughly 50 percent more electricity operating at a plant factor of 64.8 than did Italy where the plant factor was 41.8. Likewise, the installed capacity of Europe is greater than for North America but the plant factors for the United States and Canada show that the output rate per kilowatt is greater in North America.

The figures of potential water power by countries used in table 2 are based on ordinary minimum flow (flow for 95 percent of the time) and 100 percent efficiency. Estimates previous to 1937 were based on an assumed efficiency of 70 percent, and the change to 100 percent efficiency was made to put the estimates on the same basis as those for the World Power Conference. For the same reason the effect of storage has been disregarded except for constructed reservoir sites, the potential power being based on the existing flow. In the United States the potential power with existing minimum flow is 36,200,000 horsepower, but this can be doubled by construction of reservoirs at known sites. Such possibility for increase is doubtless true of most other countries. Estimates of the potential power based on the mean flow are available for only a few countries, but they are included in table 2 wherever possible. The mean flow potentials also assume 100 percent efficiency.

It should be pointed out that the estimates of potential power for the United States, Canada, and most countries of Europe are based on known sites. The estimate for Canada is low because it does not include some large known but unsurveyed sites in northern Canada. For other countries, particularly in Asia (except Japan), Africa, and South America (except Brazil), the estimates are based mostly on rainfall and topography and therefore are not as exact.

It is difficult to present in figures any exact estimate of the potential water-power resources of a country. The flow of streams varies from year to year, and the storage required to equalize the flow varies with the climate. The estimate based on the existing flow available 95 percent of the time gives the minimum power available and to some extent allows a comparison of the potential water-power resources of various countries.

The largest unsurveyed areas as well as those with the greatest water-power resources are central Africa and northern Asia. Central Africa, because of the heavy rainfall, undoubtedly has immense resources of water-power. In northern Asia there are large rivers, but, except at the headwaters, the precipitation is low and probably not well distributed. The feasibility of utilizing these resources, therefore, is dependent upon the existence of good dam and reservoir sites. Another disadvantage to this area is the distance from ocean transportation.

Lake Nyasa in Africa is an interesting example of a large water-power resource with enormous obstacles to be overcome before practical use can be made of it. The 2,300 foot-deep lake lies on a plateau about 1,600 feet above sea level. It has an area of 11,600 square miles and claims an additional 38,660-square-mile catchment area. Thirteen hundred feet of the total drop to the sea is concentrated in a 40-mile reach of the outlet stream, the Murchison Cataract of the Shire River. However, the fall does not occur until the Shire River has meandered 75 miles across flat and swamplike terrain. The country around the lake and its outlet is so flat that debris brought down tributary streams will consolidate into obstructing bars upon which vegetation grows rapidly and floating weeds accumulate, thus seriously impeding the flow of the Shire. From 1914 to 1934 such a barrage dammed the outlet to Nyasa Lake and prevented all outflow even though the lake was storing water at a rate of 6,000 cfs. If some economical method of controlling the level of the water in the lake and conducting the water through the 75-mile section to the head of the Murchison Cataract can be found, at least 1,000,000 horsepower of firm power could be produced. The need for cheap power in large amounts for metallurgical purposes will undoubtedly lead to the utilization of some of the sites in Africa, especially those within transmission distance of the coast.

In China a project has been proposed that would involve a dam 750 feet high on the Yangtze River, creating 50,000,000 acre-feet of storage capacity and having a power plant of 14,150,000 horsepower capacity. Such a dam and plant are physically possible, but the smaller sites are of greater value at present as they do not involve such large outlays of capital.

The potential water power of the United States, in horsepower, at 100 percent efficiency and gross head--for water available 95 and 50 percent of the time, and for the arithmetical mean flow under existing conditions--is shown in table 3. The effects of constructed reservoirs are reflected in this table, but no allowance is made for possible future storage. Where the center of a large stream forms the boundary between states, the power has been divided between the states. Where a dam in one state would back water into a neighboring state, the power has been divided on the basis of the length of the reservoir in each state. No tidal power is included in this estimate.

Though estimates on the basis of existing conditions for the countries of the world are comparable, they do not give a complete picture of the resources of many streams because of the omission of the effect of possible future storage. On the Colorado River, for example, primary potential power without storage will be multiplied several times by reservoirs, the construction of which is a reasonable certainty. Table 4 shows the potential water power of the United States with storage at known large reservoir sites, both developed and undeveloped. However, it does not include many small sites which undoubtedly will be developed at some future time but would not individually add materially to the potential of the stream or the country as a whole.

All computations have been made for gross head and 100 percent efficiency, resulting in a slight overstatement of the power that may be realized since the over-all efficiency of a water-power plant rarely exceeds 80 percent.

Table 1.--Installed capacity of water-power plants of the world and of the United States compared, 1920-52

Year (December) [a]	Total capacity of water-power plants (horsepower)		United States as percent of total	Comparison with 1920 (percent)	
	World	United States		World	United States
1920	23,000,000	7,500,000	32.6	100	100
1923	29,000,000	9,087,000	31.3	126	121
1926	33,000,000	11,177,000	33.9	143	149
1930	46,000,000	14,885,000	32.4	200	198
1934	55,000,000	16,075,000	29.2	239	214
1936	60,000,000	17,120,000	28.5	261	228
1938	63,900,000	17,949,000	28.1	278	239
1940	69,400,000	19,000,000	27.4	302	253
1942	71,600,000	19,816,000	27.7	311	264
1945	77,800,000	24,223,000	31.1	338	323
1947	86,900,000	24,500,000	28.2	378	327
1950	101,000,000	27,500,000	27.2	439	367
1952	115,600,000	31,000,000	26.8	502	413

a Years when estimates were made by the U. S. Geological Survey.

Table 2.--Summary, by countries, of capacity of water-power plants of the world, plant factor, potential water power at ordinary minimum flow and mean flow at 100 percent efficiency at end of 1952

Continent and country	Capacity of water-power plants (hp)	Plant factor (percent)	Potential water power (hp)	
			Based on ordinary minimum flow	Based on mean flow
Africa	714,500		250,000,000	
Asia	14,391,800		156,000,000	
Europe	48,515,500		64,000,000	
North America	46,430,200		90,000,000	
Oceani	1,778,500		23,000,000	
South America	3,962,500		62,000,000	
World (approximate)	115,793,000		645,000,000	
Africa:				
Algeria	160,000	13.5	300,000	
Anglo-Egyptian Sudan	-	-	1,000,000	
Angola	4,000	21	5,700,000	
Bechuanaland	-	-	30,000	
Belgian Congo and Belgian mandate	170,000	63	130,000,000	240,000,000
British Somaliland	-	-	(a)	
Egypt	20,000	-	500,000	1,200,000
Eritrea	-	-	(a)	
Ethiopia	5,000	50	5,700,000	
French Cameroons	14,000	-	7,000,000	
French Equatorial Africa	-	-	40,000,000	
French Guinea	-	-	3,000,000	
French Sudan and Senegal	-	-	1,400,000	
Gambia	-	-	(a)	
Gold Coast and British mandate in Togo	10,000	-	2,000,000	

See footnotes at end of table.

Table 2.--Summary, by countries, of capacity of water-power plants of the world, plant factor, potential water power at ordinary minimum flow and mean flow at 100 percent efficiency at end of 1952--Continued

Continent and country	Capacity of water-power plants (hp)	Plant factor (percent)	Potential water power (hp)	
			Based on ordinary minimum flow	Based on mean flow
Africa--Continued:				
Ivory Coast, Dahomey and French mandate in Togo	-	-	4,000,000	
Kenya	15,000	46	2,000,000	
Liberia	7,500	16	5,700,000	
Libya	-	-	(a)	
Madagascar	14,000	25	7,000,000	
Mauritius	10,000	35	(a)	
Morocco	170,000	30.0	350,000	
Mozambique	-	-	5,000,000	
Nigeria and British mandate in Cameroons	20,000	51	13,000,000	
Nyasaland	-	-	1,000,000	
Portuguese Guinea	-	-	(a)	
Rhodesia	40,500	42	3,500,000	
Rio de Oro	-	-	350,000	
Sierra Leone	-	-	2,500,000	
Somaliland	-	-	(a)	
Southwest Africa (Union of Southwest Africa mandate	-	-	200,000	
Spanish Guinea	-	-	(a)	
Spanish Morocco	15,000	28	(a)	
Tanganyika	28,500	18	4,000,000	
Tangier	-	-	70,000	
Tunisia	-	-	40,000	
Ugandi	-	-	4,000,000	
Union of South Africa	11,000	38	450,000	13,000,000
Total	714,500		249,790,000	
Asia:				
Afghanistan	25,000	27	700,000	
Burma	10,000	68	5,000,000	
Ceylon	30,000	-	500,000	
Chinese Republic	3,500	-	22,000,000	41,000,000
Formoso	250,000	44	1,000,000	
French Indo-China	200	-	6,000,000	
India	890,000	53.9	27,000,000	
Iran (Persia)	1,100	-	300,000	
Iraq and Saudi Arabia	-	-	(a)	
Israeli, Lebanon, Syria, and Trans-Jordan	50,000	-	(a)	
Japan	10,000,000	64.8	12,000,000	25,000,000
Korea	1,800,000	53.4	3,000,000	
Manchukuo	208,000	-	1,000,000	
Pakistan	20,000	42	7,000,000	
Siam and Malay States	80,000	53	5,700,000	
Turkey	24,000	27	500,000	
Union of Soviet Socialist Republics	1,000,000	37	64,000,000	[b] 325,000,000
Total	14,391,800		155,900,000	

See footnotes at end of table.

Table 2.--Summary, by countries, of capacity of water-power plants of the world, plant factor, potential water power at ordinary minimum flow and mean flow at 100 percent efficiency at end of 1952--Continued

Continent and country	Capacity of water-power plants (hp)	Plant factor (percent)	Potential water power (hp)	
			Based on ordinary minimum flow	Based on mean flow
Europe:				
Albania	8,000	-	200,000	
Austria	2,500,000	37.1	2,600,000	7,500,000
Belgium and Luxembourg	33,500	31.8	(a)	
Bulgaria	80,000	59	300,000	1,000,000
Czechoslovakia	300,000	62	700,00	1,700,000
Denmark	16,000	33.3	30,000	
Eire	250,000	36.4	500,000	
Estonia	22,000	-	100,000	
Finland	1,100,000	59.6	1,000,000	2,500,000
France	8,000,000	40.6	6,000,000	10,000,000
Germany	4,000,000	44.1	2,000,000	5,000,000
Great Britain and Northern Ireland	1,000,000	29.5	750,000	1,500,000
Greece	15,000	19.6	350,000	900,000
Hungary	20,000	59	200,000	2,000,000
Iceland	45,000	62.0	700,000	3,000,000
Italy	9,500,000	41.8	6,000,000	
Latvia and Lithuania	100,000	-	150,000	
Netherlands	1,000	-	25,000	
Norway	4,750,000	62.0	10,000,000	27,000,000
Poland	200,000	42	1,000,000	3,600,000
Portugal	500,000	32.6	600,000	
Romania	125,000	27	2,000,000	8,000,000
Spain	2,700,000	34.6	3,500,000	
Sweden	5,300,000	62.0	4,000,000	21,000,000
Switzerland	4,300,000	43.4	3,000,000	
Union of Soviet Socialist Republics	3,250,000	40	14,000,000	b 50,000,000
Yugoslavia	400,000	40.0	4,000,000	
Total	48,515,500		63,705,000	
North America:				
Alaska	48,000	-	2,000,000	
Canada	14,306,000	69.5	36,600,000	75,000,000
Costa Rica	31,000	55	1,400,000	
Guatemala	35,000	34	2,100,000	
Honduras	7,500	45	1,400,000	
Mexico	800,000	41	8,500,000	
Nicaragua	700	48	1,100,000	
Panama (including Canal Zone)	70,000	62	700,000	
Salvador	26,000	32	300,000	
United States	31,000,000	63.0	36,200,000	113,000,000
West Indies	106,000	-	200,000	
Total	46,430,200		90,500,000	

See footnotes at end of table.

Table 2.--Summary, by countries, of capacity of water-power plants of the world, plant factor, potential water power at ordinary minimum flow and mean flow at 100 percent efficiency at end of 1952--Continued

Continent and country	Capacity of water-power plants (hp)	Plant factor (percent)	Potential water power (hp)	
			Based on ordinary minimum flow	Based on mean flow
Oceani:				
Australia and Tasmania	410,000	60.8	1,000,000	
Borneo, including New Guinea and Papua	5,000	-	10,500,000	
Celebes	500	-	1,400,000	
Hawaii	25,000	-	150,000	
Java	140,000	32	1,100,000	
New Zealand	1,050,000	54.7	5,000,000	
Philippine Islands	110,000	-	2,000,000	
Sumatra	20,000	32	2,000,000	
Other Islands	18,000	-	200,000	
Total	1,778,500		23,350,000	
South America:				
Argentina	140,000	24	5,400,000	27,000,000
Bolivia	65,000	49	3,600,000	
Brazil	2,400,000	32	20,000,000	
British Guiana	-	-	3,600,000	
Chile	550,000	43	7,000,000	
Columbia	200,000	38	5,400,000	
Dutch Guiana	-	-	1,100,000	
Ecuador	22,000	38	1,300,000	
French Guiana	-	-	700,000	
Paraguay	500	-	2,800,000	
Peru	325,000	26	6,400,000	
Uruguay	180,000	47	400,000	
Venezuela	80,000	53	4,300,000	
Total	3,962,500		62,000,000	

a Small.
b Available 50 percent of the time.

Table 3.--Potential water power, in horsepower, of the United States, existing flow, 100 percent efficiency, and gross head

State and division	Available 95 percent of the time	Available 50 percent of the time	Based on mean flow
New England	1,052,000	2,455,000	3,669,000
Middle Atlantic	4,465,000	7,864,000	9,862,000
East North Central	1,013,000	2,296,000	3,480,000
West North Central	1,667,000	3,238,000	4,947,000
South Atlantic	2,067,000	5,176,000	7,663,000
East South Central	2,660,000	5,035,000	7,473,000
West South Central	667,000	1,256,000	2,769,000
Mountain	7,904,000	14,709,000	25,698,000
Pacific	14,965,000	33,149,000	50,000,000
United States	36,460,000	75,178,000	115,561,000
New England:			
Maine	463,000	1,108,000	1,515,000
New Hampshire	295,000	552,000	917,000
Vermont	107,000	276,000	429,000
Massachusetts	134,000	322,000	502,000
Rhode Island	7,000	19,000	28,000
Connecticut	46,000	178,000	278,000
Middle Atlantic:			
New York	4,183,000	6,452,000	7,677,000
New Jersey	12,000	86,000	125,000
Pennsylvania	270,000	1,326,000	2,060,000
East North Central:			
Ohio	25,000	109,000	209,000
Indiana	54,000	186,000	327,000
Illinois	284,000	711,000	1,136,000
Michigan	319,000	571,000	842,000
Wisconsin	331,000	719,000	966,000
West North Central:			
Minnesota	215,000	528,000	857,000
Iowa	109,000	331,000	546,000
Missouri	418,000	939,000	1,408,000
North Dakota	232,000	323,000	443,000
South Dakota	519,000	763,000	1,139,000
Nebraska	123,000	217,000	343,000
Kansas	51,000	137,000	211,000
South Atlantic:			
Delaware	2,000	7,000	11,000
Maryland and the District of Columbia	80,000	334,000	550,000
Virginia	253,000	762,000	1,219,000
West Virginia	245,000	1,054,000	1,601,000
North Carolina	461,000	1,133,000	1,455,000
South Carolina	579,000	1,027,000	1,226,000
Georgia	439,000	823,000	1,519,000
Florida	8,000	43,000	82,000

Table 3.--Potential water power, in horsepower, of the United States, existing flow, 100 percent efficiency, and gross head--Continued

State and division	Available 95 percent of the time	Available 50 percent of the time	Based on mean flow
East South Central:			
Kentucky	316,000	617,000	1,168,000
Tennessee	1,328,000	2,380,000	3,243,000
Alabama	966,000	1,904,000	2,687,000
Mississippi	50,000	134,000	375,000
West South Central:			
Arkansas	135,000	333,000	888,000
Louisiana	51,000	97,000	330,000
Oklahoma	181,000	416,000	791,000
Texas	300,000	410,000	760,000
Mountain:			
Montana	1,494,000	2,454,000	4,291,000
Idaho	2,750,000	5,381,000	9,264,000
Wyoming	282,000	554,000	1,324,000
Colorado	385,000	1,184,000	2,323,000
New Mexico	91,000	182,000	322,000
Arizona	1,548,000	2,642,000	4,184,000
Utah	791,000	1,743,000	3,420,000
Nevada	563,000	569,000	570,000
Pacific:			
Washington	6,651,000	15,824,000	25,000,000
Oregon	4,492,000	9,172,000	12,500,000
California	3,822,000	8,153,000	12,500,000

Table 4.--Potential water power, in horsepower, of the United States, existing storage and assumed development of known storage sites, 100 percent efficiency, and gross head

State and division	Available 90 percent of the time		Available 50 percent of the time	
	Horsepower	Percent	Horsepower	Percent
New England	1,538,000	2.35	2,545,000	2.94
Middle Atlantic	6,505,000	9.95	8,415,000	9.82
East North Central	1,241,000	1.90	2,342,000	2.75
West North Central	2,701,000	4.13	3,646,000	4.27
South Atlantic	4,200,000	6.43	5,801,000	6.79
East South Central	3,976,000	6.08	5,670,000	6.62
West South Central	1,407,000	2.15	1,830,000	2.14
Mountain	16,939,000	25.91	19,530,000	22.78
Pacific	26,867,000	41.10	35,876,000	41.89
United States	65,374,000	100.00	85,655,000	100.00
New England:				
Maine	749,000	1.15	1,151,000	1.30
New Hampshire	397,000	.61	596,000	.70
Vermont	134,000	.20	277,000	.32
Massachusetts	177,000	.27	323,000	.38
Rhode Island	7,000	.01	19,000	.02
Connecticut	74,000	.11	179,000	.22
Middle Atlantic:				
New York	5,649,000	8.64	6,903,000	8.06
New Jersey	46,000	.07	86,000	0.10
Pennsylvania	810,000	1.24	1,426,000	1.66
East North Central:				
Ohio	44,000	.07	110,000	.13
Indiana	85,000	.13	227,000	.27
Illinois	306,000	.47	710,000	.83
Michigan	386,000	.59	571,000	.67
Wisconsin	420,000	.64	724,000	.85
West North Central:				
Minnesota	300,000	.46	554,000	.65
Iowa	137,000	.21	331,000	.39
Missouri	696,000	1.06	1,061,000	1.24
North Dakota	374,000	.57	386,000	.45
South Dakota	827,000	1.27	854,000	1.00
Nebraska	263,000	.40	313,000	.37
Kansas	104,000	.16	147,000	.17
South Atlantic:				
Delaware	3,000	.00	7,000	.01
Maryland and the District of Columbia	286,000	.44	409,000	.48
Virginia	667,000	1.02	930,000	1.09
West Virginia	804,000	1.23	1,121,000	1.31
North Carolina	831,000	1.27	1,170,000	1.37
South Carolina	681,000	1.04	1,074,000	1.25
Georgia	889,000	1.36	1,041,000	1.22
Florida	39,000	.06	49,000	.06

Table 4.--Potential water power, in horsepower, of the United States, existing storage and assumed development of known storage sites, 100 percent efficiency, and gross head--Continued

State and division	Available 90 percent of the time		Available 50 percent of the time	
	Horsepower	Percent	Horsepower	Percent
East South Central:				
Kentucky	557,000	0.85	780,000	0.91
Tennessee	1,829,000	2.80	2,571,000	3.00
Alabama	1,400,000	2.14	2,100,000	2.45
Mississippi	190,000	.29	219,000	.26
West South Central:				
Arkansas	554,000	.84	740,000	.86
Louisiana	77,000	.12	99,000	.12
Oklahmoa	326,000	.50	477,000	.56
Texas	450,000	.69	514,000	.60
Mountain:				
Montana	2,770,000	4.24	3,359,000	3.92
Idaho	4,530,000	6.93	5,870,000	6.85
Wyoming	573,000	.88	757,000	.88
Colorado	1,360,000	2.08	1,636,000	1.90
New Mexico	223,000	.34	291,000	.34
Arizona	4,588,000	7.02	4,613,000	5.39
Utah	2,205,000	3.37	2,308,000	2.69
Nevada	690,000	1.05	696,000	.81
Pacific:				
Washington	12,711,000	19.44	17,414,000	20.33
Oregon	6,753,000	10.33	8,999,000	10.51
California	7,403,000	11.33	9,463,000	11.05
Outlying possessions:				
Alaska	7,143,000	-	9,286,000	-
Puerto Rico	27,000	-	40,000	-
Hawaii	103,000	-	250,000	-

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