is wealthier, on the average, than that of smaller communities and most likely discards larger quantities of waste.

In evaluating the dollar expenditures in this table, it must be remembered that the setup of the original cost data in local governments is not particularly suited for statistical purposes or comparisons. It is particularly doubtful that all costs are accurately reflected in the figures reported by smaller communities.

TABLE VI.—*Governmental expenditures for sanitation, other than sewerage, 1962, by size of population on a county area basis*

County area population (thousands) [1]	Expenditures			U.S. population 1960 [2] (thousands)	U.S. population distribution (percent)	Number of areas	
	In millions	Percent of total	Per capita			County areas United States [3]	U.S. distribution (percent)
Total	$686	100.0	[4] $3.83	179,323	100.0	3,124	100.0
250 and over	513	74.8	5.87	87,432	48.9	123	3.9
100 to 249.9	78	11.4	2.84	27,566	15.4	176	5.6
50 to 99.9	43	6.3	2.12	20,319	11.4	293	9.4
25 to 49.9	32	4.6	1.52	20,890	11.6	588	18.8
10 to 24.9	16	2.4	.90	18,028	10.0	1,096	35.0
Under 10	4	.5	.73	509	.2	848	27.3
				4,579	[5] 2.5		

[1] Refers to county area as used in the 1962 Census of Governments.
[2] Refers to the areas covered in the 1962 Census of Governments.
[3] Includes areas corresponding to counties but having no organized county government.
[4] It should be noted that this figure is based on the entire U.S. population including rural areas receiving no service. Per capita costs in urban areas are thus higher.
[5] Population not covered in the 1962 U.S. Census of Governments survey.

Source: U.S. Department of Commerce, Bureau of Census, data revised October 1964.

The 1962 U.S. Census of Governments contains a first attempt to measure the expenditures for sanitation, other than sewerage, separately. It excludes any applicable debt service payments which are estimated to add about $80 to $120 million to the operating, maintenance, and capital investments as indicated. Furthermore, local governments frequently omit the 15 to 20 percent of worker fringe benefit cost as well as any applicable overhead in reporting expenditures by function. In addition, some communities operate their repair and maintenance facilities on a centralized basis while others do not. Personnel and equipment frequently are utilized for more than one function and costs are not uniformly allocated among local units of government. Comprehensive in-depth studies conducted by the APWA of actual expenditures in selected cities suggest that the total annual cost of collecting and disposing of solid wastes might range from $1.2 to $1.5 billion for the governmental sector alone.

The foregoing table, of course, excludes the cost of private refuse disposal service which, including all small communities and unincorporated areas, is frequently estimated to amount from 80 to 100 percent of the total public collection and disposal expenditures. In addition, substantial sums of money are spent on refuse containers, garbage grinders and on-site incinerators by the tax-paying public. Thus, it is reasonable to conclude that the total U.S. refuse collection and disposal expenditures probably exceed $2.2 billion and may range as high as $3 billion per year. Previous studies made by APWA as well as others support estimates of larger expenditures in this field.

The census data are used in this report since they represent a first attempt to obtain the needed information on a nationwide basis. More accurate data undoubtedly will be forthcoming in future years, as uniform accounting and reporting procedures are more widely adopted.

(d) *Age Distribution of Facilities*

Based on two surveys made in the late 1950's and the estimated incinerator building activity since then, it is estimated that 28 percent of the incinerators were built prior to 1941, about 59 percent during 1941–60, and about 13 percent since 1961.

The ages of open dumps and sanitary landfills are difficult to estimate. The service life of these installations varies greatly, depending mainly upon fill-depth, degree of compaction, and size of the area.

(e) *Ownership of the Facilities Now In Operation*

Noncaptive refuse collection and disposal facilities are generally owned by local governments or private profitmaking organizations or individuals. None are known to be owned by State governments, State agencies, the Federal Government, or by private, nonprofit organizations and cooperatives. The ownership relationship between local governments (municipalities, townships, counties, and special districts) and proprietary profitmaking organizations is estimated to be as follows:

TABLE VII.—*Estimated distribution of ownership of refuse collection-and-disposal equipment and installations, 1965*

Type of refuse collection-and-disposal equipment and installations	Percent owned by—	
	Local government	Private, for profit organizations
Collection vehicles	55	45
Garage and maintenance facilities	75	25
Incinerators	99	1
Open dumps:		
Urban areas	50	50
Rural areas	75	25
Sanitary landfills:		
Urban areas	60	40
Rural areas	90	10

Source: APWA estimates, 1964 APWA-USPHS survey of refuse collection practices.

(f) *The Estimated Current Value of Refuse Collection and Disposal Facilities*

In the absence of any data on the current value of refuse disposal investments it was decided to use past replacement values taking into account the past conditions in the state of the art of the disposal equipment technology. Local governments do not tend to use capital investment accounting methods including depreciation and other value (land value) adjustments. Sanitary landfills, if properly operated and completed, often represent land investments of considerable value.

For the present analysis the value of the incinerators is calculated at $2,500 to $3,000 a ton of installed capacity. The value of the collection facilities is calculated at an average of $10,000 per vehicle plus 12 percent, according to a 1966 APWA survey, for equipment storage

and maintenance facilities. The value per sanitary landfill is calculated at an average size of 15 to 30 acres, the cost per acre being $1,500. Land costs are estimated to represent about 40 to 45 percent of the total sanitary landfill value, including operating equipment. Thus, the past investment value per average sanitary landfill can range from $50,000 to $112,000. Open dumps, finally, are valued at land cost alone. Considering the large number of open dumps in small rural communities and the smaller sizes of open dumps, it is estimated that each open dump represents an investment of about $500. In contrast to open dumps, most sanitary landfills are located in urban areas where the land prices are substantially higher.

In accordance with the foregoing discussion, the value of refuse collection equipment and disposal facilities at actual acquisition costs is estimated as follows:

TABLE VIII.—*Investment value (at cost) of refuse collection equipment and disposal facilities, 1965*

	Millions of dollars
82,000 tons of incinerator capacity	205. 0–246. 0
1,071 sanitary landfills	53. 5–120. 0
19,372 open dumps	9. 5– 9. 5
30,000 to 40,000 collection vehicles	300. 0–400. 0
12 percent equipment storage and maintenance facilities	36. 0– 48. 0
Total	604. 0–823. 5

Source: APWA estimates and calculations.

The foregoing data on sanitary landfills exclude the investment value of completed sanitary landfill areas which are still held as property of the community. In case of a sanitary landfill, the land value usually increases because of land improvements produced by proper sanitary landfill operations. Thus in a strict sense the current value of a sanitary landfill cannot be compared to the current value of an incinerator installation.

B. Cost and User Charges

1. CONSTRUCTION COST AND OPERATING COSTS

(a) *Construction Cost for Facilities of Long-Time Durability*

Construction costs per ton of incinerator capacity have customarily been estimated to range from $3,000 to $6,000. However, a 1966 survey of eight incinerators just completed or still under construction indicates an average construction cost of $4,500 per ton/24-hour daily capacity. Construction cost increases considerably if air pollution control equipment, automated process controls, highly mechanized operations, and adequate storage facilities for the raw refuse are provided. The current construction costs for an incinerator utilizing the improvements available from modern technology are estimated to average $5,000 to $7,000 per ton/24-hour daily capacity. The cost could go as high as $8,000 to $10,000 per ton/24-hour daily capacity for plants incorporating heat recovery systems and buildings suitable for cold climates.

The development "construction" cost for sanitary landfills includes access roads, water, drainage facilities, equipment sheds, fencing, lighting, and site beautification. A 1964 survey of 10 sites in Penn-

sylvania indicates that these costs are approximately $55,000 for a 30-acre site. Of course, these costs can vary considerably depending on the terrain, location, and size. Converted to a 10-acre site, the sanitary landfill development costs are estimated at about $18,000. These cost figures exclude the acquisition cost for land and operating equipment. The equipment costs are estimated to average $35,000 to $40,000 per site, considering all sites in the country.

The current cost for suitable refuse collection equipment is estimated as follows:

Regular compactor trucks: 10 to 20 cubic yards; $10,000 to $13,000 each.

Heavy duty compactor trucks: 24 to 28 cubic yards; $15,000 to $20,000 each.

Trailers: 30 to 80 cubic yards; $25,000 to $30,000 each.

Compactor truck with detachable container and hoisting unit: $15,000 to $30,000.

Trailers are used in connection with transfer stations where the refuse is transferred from the smaller collection trucks to the trailers. Transfer stations reduce hauling costs if the hauling distances are great. However, according to a 1964 APWA survey on refuse collection practices, less than 4 percent of the U.S. refuse collection agencies use transfer stations at the present time.

(b) *Typical Maintenance and Operation Expenses for Collection and Disposal Facilities*

The operation and maintenance costs of incinerators vary widely depending upon the plant capacity, efficiency of operations, local wages, the type of refuse burned, the degree of burning, the number of shifts worked per day, and the type of plant; that is, whether it is mechanized or requires manual stoking. Variations in incinerator operating and maintenance costs are reported to range from $0.50 to more than $7 per ton of refuse burned. Based on data from 60 incinerator operations, it is estimated that, excluding amortization cost, average maintenance and operation costs range from $2.90 to $3.60 per ton of refuse burned. The annual maintenance costs are reported to amount to about 5 percent of the total capital cost or approximately 10 to 15 percent of the total annual cost of incinerator plant operation.

The operation and maintenance costs for sanitary landfills, too, vary widely. They depend mainly upon the soil conditions, availability of cover material, the type of equipment used, local wages, operations efficiency, and the size of the operation. A cost range of $1 to $1.50 per ton of refuse is frequently reported. A survey made for this report on the operating cost of 50 sanitary landfill operations suggests that the average operating and maintenance cost is about $1.10 per ton of compacted refuse deposited. By contrast, the cost of disposal in open dumps/modified landfills ranges from $0.05 to $0.25 per ton. This cost comparison of the various disposal methods indicates why there are so many open dumps in this country and why many supposedly sanitary landfills are not operated as such.

Collection accounts for the bulk of refuse removal costs. Ranging from $5 to $25 per ton, collection costs are commonly estimated to make up 65 to 80 percent of total disposal cost. The transportation

cost, excluding depreciation of equipment, of a typical 18- to 22-cubic-yard-packer truck carrying from 3 to 4 tons of compacted refuse, is estimated at $0.35 to $0.40 per mile. The average trip is estimated to be between 10 and 25 miles in distance.

2. USER CHARGES

(a) *The Extent to Which User Charges Are Employed to Pay for Refuse Collection and Disposal Services*

User charges are not uniformly employed throughout the country to pay for refuse collection and disposal services by local governments. They vary from a high of $3.30 per capita per year based upon the entire population of the State of New Mexico to a low of less than 1 cent or no charges at all for New Hampshire, Delaware, and the District of Columbia. A breakdown of user charges by State is given in table IX below.

In evaluating the data given in the table on the following page, it must be recognized that per capita expenditures and service charges tend to be substantially higher if they are calculated on the basis of the population actually served. A tabulation of per capita expenditures and service charges for refuse collection only, calculated on the basis of the population actually served, is given in table X.

TABLE IX.—*Per capita expenditures and revenue from service charges [1] for sanitation, other than sewerage, 1962, by State*

State	Expenditure [2]	Revenue charges	State	Expenditure [2]	Revenue charges
United States	$3.83	$0.68	Missouri	$1.67	$0.17
Alabama	1.93	.31	Montana	2.36	1.63
Alaska	2.70	1.86	Nebraska	1.85	.19
Arizona	4.82	.58	Nevada	1.08	.13
Arkansas	1.14	1.10	New Hampshire	2.59	
California	3.44	1.41	New Jersey	4.69	.09
Colorado	2.26	.27	New Mexico	3.85	3.30
Connecticut	3.77	.14	New York	8.37	.46
Delaware	2.29		North Carolina	2.23	.01
District of Columbia	10.9		North Dakota	1.83	1.45
Florida	4.97	2.42	Ohio	3.42	.56
Georgia	3.27	1.11	Oklahoma	2.06	2.45
Hawaii	5.51	.83	Oregon	1.02	.11
Idaho	1.96	1.04	Pennsylvania	3.51	.27
Illinois	4.79	.26	Rhode Island	2.95	.01
Indiana	1.99	.04	South Carolina	2.18	.02
Iowa	1.98	.16	South Dakota	1.08	.28
Kansas	1.85	1.15	Tennessee	2.69	.08
Kentucky	1.61	.27	Texas	3.18	1.59
Louisiana	3.38	.38	Utah	1.83	.35
Maine	1.11	.02	Vermont	.75	.01
Maryland	3.75	.84	Virginia	2.72	.12
Massachusetts	4.56	.05	Washington	2.86	2.46
Michigan	3.89	.23	West Virginia	1.62	1.10
Minnesota	1.66	.34	Wisconsin	4.46	.04
Mississippi	1.58	.07	Wyoming	3.34	2.48

[1] Data refer only to total governmental expenditures and revenues for refuse removal divided by the total State population.

[2] Expenditures do not include debt service and retirement payments.

Source: U.S. Department of Commerce, Bureau of the Census.

TABLE X.—*Range in annual 1960 per capita cost for refuse collection of 38 public agencies financing their system exclusively through service charges, by type of service*

Extent and character of service	Number of cities	Maximum	Median	Minimum
Complete residential and commercial service (all classes and almost all kinds of refuse collected)	25	$7.40	$5.02	$2.04
Complete residential service only (some small commercial establishments may be included)	6	3.72	2.57	.64
Citywide service, but some kinds of refuse not collected or 1 or 2 classes omitted from business area	4	4.58	4.01	2.25
Only 1 class of refuse collected in residential area or business area or partial service throughout the agency	3	3.25	2.78	.24

Source: APWA Refuse Collection Practice, 3d edition, scheduled for publication in the late summer of 1966.

The table indicates the great differences in cost and user charges at various levels of service. Again, caution should be exercised in drawing conclusions. Some of the differences are due to variations in wage rates, population densities, collection methods, length of hauls, and other factors.

Finally, surveys conducted by APWA in 1955 and 1964 indicate that the number of cities using service charges to finance all or part of their refuse collection increased by about 20 percent in the 1955–64 time period. The current status of financing refuse collection in communities of various sizes is shown in table XI on the following page.

The data shows that the smaller communities tend to rely more on service charges than do the larger communities.

(b) *Extent to Which User Charges Cover Annual Maintenance and Operation Expenses Plus Debt Service*

User charges significantly exceed the sum of prorated operating and capital costs only in communities where refuse disposal is exclusively handled by private companies. This is the case in less than 13 percent of the Nation's communities according to a 1964 APWA survey of refuse collection practices.

TABLE XI.—*Method of financing refuse collection services, 1964, by size of community*

Population size of community	Distribution of financing methods in percent					
	Total		General tax	Service charge	Tax and service charge	Other
	Number of communities in sample	Percent				
5,000 to 9,999	180	100	47.2	39.0	13.4	0.6
10,000 to 24,999	307	100	46.0	38.0	16.0	0
25,000 to 49,999	190	100	51.5	32.7	14.2	1.6
50,000 to 99,999	93	100	58.0	28.0	12.9	1.1
100,000 to 999,999	74	100	59.5	27.0	13.5	0
1,000,000 and over	6	100	66.6	0	33.4	0
Total sample	850	100	50.1	34.9	14.4	.6

Source: Survey made in 1964 by APWA in cooperation with the U.S. Public Health Service.

According to the 1962 U.S. Census of Governments, user charges, on a nationwide basis, cover only 17.6 percent of the governmental operating and maintenance expenditures for sanitation other than

sewerage. Including debt service, user charges cover only 10 to 12 percent of the governmental refuse removal expenditures. Details of the relationships between user charges and expenditures by type of government are given in table XII.

TABLE XII.—*Expenditures and revenue in sanitation other than sewerage for local governments, 1962*

[Dollar amounts in millions]

Type of local government	Expenditures		Sanitation other than sewerage revenue from current charges	
	Amount [1]	Percent distribution	Amount	Percent distribution
Total	$981–$1,200	100.0	$121	100.0
Counties	27– 31	2.8	7	5.8
Municipalities	893– 1,100	91.0	105	86.8
Townships	51– 58	5.2	4	3.3
Special districts	10– 11	1.0	5	4.1

[1] APWA calculations.

Source: U.S. Department of Commerce, Bureau of the Census.

In the private refuse disposal field, user charges, of course, must cover all expenditures.

(c) *Extent to Which the Costs of Refuse Disposal Facilities Are Met Out of the General Tax Resources and General Obligation Bonds*

According to APWA surveys, it is estimated that about 35 to 36 percent of the communities finance their refuse collection and disposal operations through service charges, 50 to 52 percent through general taxes, and 12 to 15 percent through a combination of taxes and service charges.

The extent to which general obligation borrowings of local governments are used for this purpose is not known. However, it is believed that the cost for acquiring incinerators in many cases is financed through general obligation bond issues. Revenue bonds amortized by service charges have also been issued for such purposes.

C. TRENDS OF CAPITAL OUTLAYS

1. THE TRENDS OF ANNUAL CAPITAL OUTLAYS FOR REFUSE COLLECTION AND DISPOSAL FACILITIES DURING THE 1946–65 PERIOD

Suitable data on the annual capital outlays for refuse collection and disposal facilities during the 1946–65 period are not available. However, based on estimates obtained by the APWA from 47 communities, it is estimated that from $725 to $950 million were expended for capital outlays during the 1956–65 decade. This amount is estimated to break down from $467 to $612 million for collection equipment and facilities, $87 to $114 million for sanitary landfills and $171 to $224 million for incinerators. Based on the same survey, the total capital investment for refuse removal facilities during the 1946–55 decade is estimated at about $325 to $450 million.

The estimates for the past decade appear to be valid if one considers that the capital investments have not been spread evenly over 1956–65.

It is estimated that in 1956 the capital investments amounted to $35 to $50 million while in 1965 they may have reached a rate as high as $145 to $180 million per annum. Furthermore, surveys of selected cities indicate that capital expenditures (including debt service and new investments) amount to about 10 to 15 percent of the total refuse removal cost. Thus, if the total annual refuse removal cost is estimated at $2.5 billion, total capital expenditures would amount to $250 to $375 million per year. Deducting about $120 million for debt service consequently would suggest that current capital investments range between $130 to $255 million per annum. Therefore, it is reasonable to conclude that the current capital investment in the refuse collection and disposal field amounts to approximately $170 million per year.

Breakdown of Capital Outlays by Investor

All capital outlays, during the 1956–65 decade, for the establishment of refuse disposal facilities were made by local governments or proprietary, profitmaking organizations. It is estimated that local governments expended about 70 to 75 percent of the total amount and private organizations the remaining 25 to 30 percent. Expenditures by local governments at 72 percent of the total are estimated to include $170 to $222 million for incinerators, $70 to $93 million for sanitary landfills and about $280 to $370 million for collection equipment and maintenance and storage facilities.

2. SOURCES OF FINANCING FOR CAPITAL OUTLAYS

The sources of financing for these capital outlays include appropriations from tax sources, tax exempt municipal bonds, borrowings from banks, and private venture capital.

It is assumed that almost all incinerators (99 percent or $170 to $222 million) were financed through tax exempt municipal bonds while almost all of the remaining municipal investments in equipment, landfills, etc. (90 percent or $315 to $415 million) were financed by appropriations from tax revenues or service charges. Thus, about 43.5 percent of the total capital investments were financed by appropriations from general tax revenues and service charges and about 28.5 percent by municipal bonds. The remaining 28 percent is estimated to have been financed mainly by private, profitmaking organizations through borrowings from banks and by owner-capital.

D. Needs and Prospective Capital Outlays

Industrial and technological changes plus an increase in living standards are resulting in the production of ever-increasing quantities of refuse, per person. This increase, coupled with the anticipated population growth, results in staggering amounts of solid wastes that must be regularly collected, transported and disposed of.

1. THE ESTIMATED CAPITAL REQUIREMENTS FOR REFUSE COLLECTION AND DISPOSAL FACILITIES DURING THE 1966–75 DECADE

Conditioned upon the present situation, the capital requirements for noncaptive refuse collection aud disposal facilities during the 1966–75 decade are estimated to be at least $2.42 billion in 1965 dollars.

This estimate is based on a survey of the capital investment needs for waste disposal facilities recently conducted by the APWA in 47 communities and the findings of the previous analyses. The amounts of these capital investment demands are estimated to be as follows: $1.420 billion for collection equipment and storage and maintenance facilities, $340 million for sanitary landfills including land and equipment and $660 million for incinerators.

(a) *Factors Taken into Account in Making This Projection*

Excepting salvage operations such as hog feeding and composting, it is common to all disposal methods that, in one form or another, solid wastes have to be returned directly to the natural environment by acceptable means. The space requirements vary according to the method used and are as follows:

TABLE XIII.—*Land requirements for selected refuse disposal methods*

Disposal method	Percent reduction of volume of raw refuse	Population served annually by 1 acre-foot	Acre-feet required annually for each 10,000 population
Open dump (raw, mixed refuse)	0	412	24.2
Open dump with burning, scavenging, and casual compaction	15	487	20.5
Sanitary landfill	50	1,430	7.0
Incineration	90	2,080	4.8

Source: U.S. Public Health Service; APWA; and various waste disposal planning studies.

However, land required for waste disposal facilities is also in demand for many other more attractive uses in the metropolitan and urban centers. This, coupled with higher costs through an increase in the hauling distances to landfills, is judged to create a strong demand for modern incinerators during the next decade.

The $660 million investment need for incinerators includes an allowance of from 3 to 5 percent of this amount for land acquisition. The need for replacement of obsolete facilities is estimated to amount to 40 percent of the presently installed 82,000 tons daily, 24-hour incinerator capacity. Almost 30 percent of the existing capacity is estimated to have been built prior to 1941. Calculated at a construction cost of $6,000 per ton of daily, 24-hour capacity, this capital investment would add 109,000 tons of daily capacity to the present total capacity, whereas 33,000 tons of daily capacity would be eliminated because of obsolescence. Thus, the 1975 installed incinerator capacity is estimated at 158,000 tons per 24-hour day of operation. In support of this estimate it might be mentioned that a manufacturer of incinerator equipment forecasts, for 1975, an incinerator capacity of 120,000 to 145,000 tons per day. However, this forecast is based on a normal expansion of the demand and does not provide for stepped-up Federal activities in this field.

In estimating the sanitary landfill capital investment needs it is assumed that open dumps will be eliminated wherever feasible. However, inert waste materials, such as incinerator ash and certain demolition wastes, do not require sanitary landfills for adequate disposition. Furthermore, open dumps tend to be smaller in area than sanitary landfills. Thus a number of open dumps will not be converted to sanitary landfills but will be used for the disposal of inert

materials. Consequently it is assumed that about 30 percent of the existing open dumps in urban areas will not be converted to sanitary landfills, leaving about 4,000 open dumps to be converted. Since not all of these open dumps are located in or near metropolitan areas, nor do they belong to outlying communities in a metropolitan complex, their capital investment values for conversion to landfills is calculated at $50,000 each. In turn, the conversion of open dumps to sanitary landfills is estimated to require about $200 million during the 1966–75 decade.

In addition, it is estimated that about half of the existing 1,000 sanitary landfills will need replacement in the 1966–75 decade at an average cost of $80,000 each. This will add $40 million to the sanitary landfill investment needs.

It seems that the waste disposal needs in rural areas do not presently justify that each of the 13,600 communities be required to operate a sanitary landfill. Consequently, it may be assumed that refuse disposal in rural areas will be operated, more or less, on a countywide basis. This in turn might suggest that about 70 percent of the existing open dumps in rural areas will be closed. Because of their smaller size and lower land costs, the capital investment needs for sanitary landfills in rural areas are estimated at $25,000 each, including part of the cost for the equipment needed. Thus, the capital investment needs for 4,100 sanitary landfills in rural areas are estimated to be approximately $100 million. The equipment for sanitary landfills in rural areas will not be used on a full-time basis for landfill operations.

The capital investment needs for collection and transfer equipment plus maintenance and storage facilities are estimated at $1.42 billion during the 1966–75 decade. This includes the replacement of almost all noncompactor trucks of existing truck fleets, costing an average of $13,000 each. The current proportion of noncompactor units, including open trucks, is estimated at 30 percent of the total fleet, thus requiring a replacement of 10,000 to 12,000 units resulting in an investment of $130 to $156 million. Of course, not all of the open trucks will need to be replaced since a certain number of such trucks will be needed for the collection of oversized (bulky) wastes. In addition, it is estimated that the average sanitary landfill in rural areas would be served by four heavy duty compactor collection vehicles of 24 to 28 cubic yard loading capacity to minimize the cost impact of long-distance hauling. The cost of these vehicles is calculated at $20,000 each. Therefore, the 16,400 vehicles required for the waste disposal service in rural areas would require $328 million in capital investments. Consequently, about 34 percent of the total estimated capital investment needs for refuse collection facilities are judged to be needed for providing service where none currently exists or updating the current service to acceptable levels. The remaining $936 million are estimated to be needed for the replacement of worn out compactor trucks, the purchase of new vehicles, and the provision of the necessary maintenance and storage facilities.

The foregoing estimates have been made on the assumption of a population growth from 195 million people in 1965–66 to 230 million in 1975. In addition, it has been estimated that the production, collection, and disposal of solid wastes will increase, on a nationwide average from the present 0.75 ton per capita per year to 1 ton per capita per year in the next decade.

The foregoing estimates appear to be reasonable in the light of the capital requirement projections made by 20 metropolitan or regional planning commissions in urban and in some urban rural areas. These agencies in 1966 estimated that each of them should, realistically, spend an average of $7.5 million during the 1966–75 decade, on capital investments for refuse collection and disposal facilities. Since there are 216 metropolitan urban areas in this country, their total capital investment needs are calculated at $1.6 billion. Since such areas, however, account for about 70 to 75 percent of the population, the total U.S. investment needs on this basis can be extrapolated to $2.1 billion to $2.3 billion.

A graphic presentation of the trends in annual expenditures for sanitation on the State and local government levels is given in exhibit I (following) for comparison purposes. The exhibit indicates that those expenditures grow much faster than the population. This is in line with the findings of waste disposal studies made for a number of areas or regions in the United States. Some of these studies reveal that the collection and disposal of solid wastes increased at twice the rate of population growth.

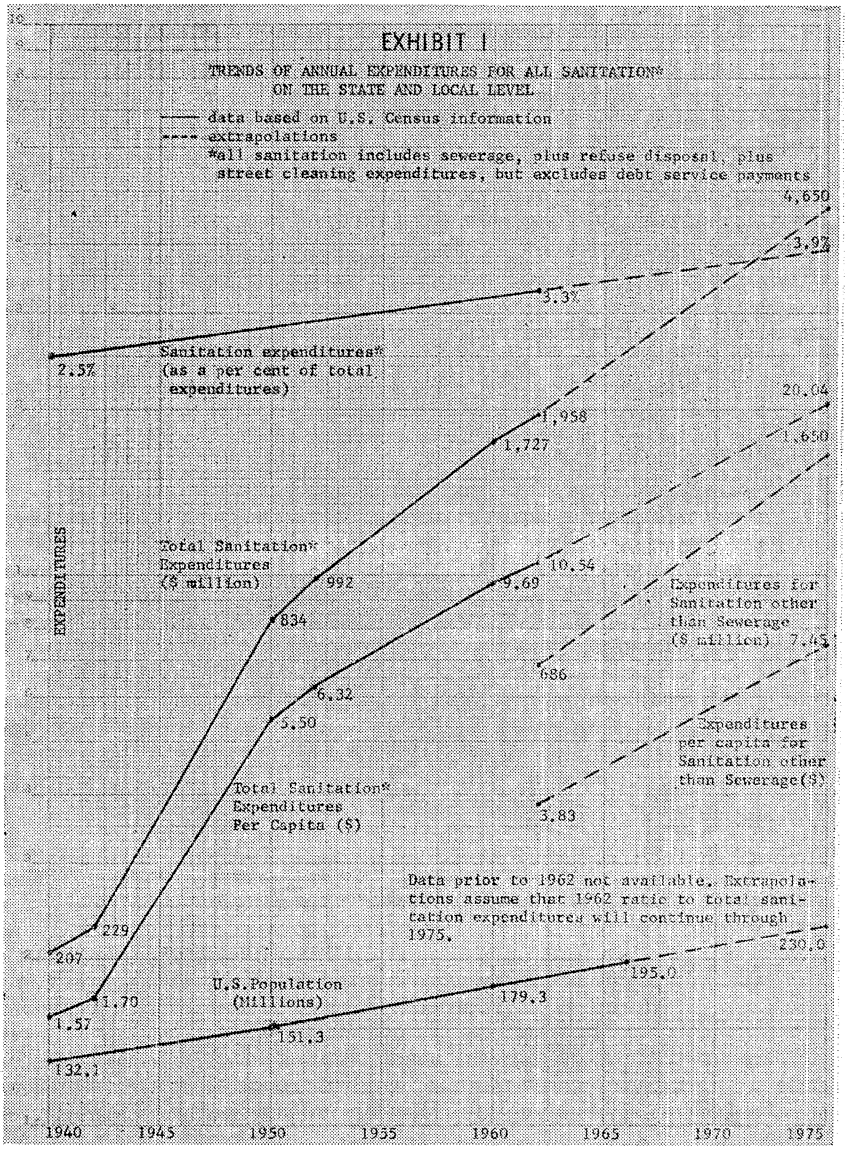
(b) *Capital Investment Needs on an Annual Basis*

If the projected needs were to be financed over the next decade in equal proportions, the annual investment would amount to approximately $240 million per year. If the backlog, which is estimated to be at least 34 percent of the investment needs, were to be funded during the first year of the decade, about $820 million would be required. Spreading the remaining $1.6 billion evenly over the 10-year period would add $160 million to the first year's requirements. Thus, it would be necessary to provide more than 40 percent, or $980 million, of the total $2.42 billion capital investment needs during the first year. The remaining $1.44 billion would be required at a rate of $160 million annually during each of the remaining 9 years. Of this amount, approximately $90 million would be required by local government, and $70 million by private entrepreneurs.

(c) *Distribution of the Investment Needs by Type of Area and Size of Community*

According to the foregoing analyses, $428 million, or 17.8 percent of the total investment needs, are estimated to be needed in rural communities. In addition, it is estimated that communities in urban areas with a population of less than 2,500 people will require about 2.2 percent of the total capital need. It is also noted that most of these communities receive their refuse disposal service in conjunction with that of other urban communities in metropolitan areas. Therefore, it is estimated that agricultural areas and communities with a population under 2,500 persons will require 20 percent, or $488 million, of the total capital investment needs. In turn, 80 percent, or $1.932 billion, would be spent in communities with a population of 2,500 or more people. According to the U.S. census, people living in such communities are considered as living in urban areas.

It is extremely difficult to make valid estimates of the capital investment needs in different population categories. In order to make such projections, as requested, it is necessary to make some more or less arbitrary assumptions, and use information which is subject to further refinement. If, for example, population distribution and past spend-



ing patterns of expenditures are used, the following estimates could be made. According to the 1960 U.S. census, 52 percent of the population at that time resided in communities of more than 50,000 inhabitants and 63 percent in metropolitan areas. According to the 1962 U.S. Census of Governments about 79 percent of all expenditures for sanitation other than sewerage was expended in metropolitan areas and about 92.5 percent in communities with a population of more than 50,000 people. To ameliorate the impact of the disproportionately large past expenditure patterns in large urban areas with the require-

ments for adequate service, it was decided to average the percentages of population and spending patterns. It is estimated that of the $1.932 billion needed in urban communities with 2,500 or more inhabitants about 70 percent, or $1.35 billion, might reasonably be allocated for communities with more than 50,000 inhabitants. This represents about 56 percent of the total $2.4 billion needed. The remainder of $582 million, or 24 percent of the total, is estimated to be needed in communities with populations between 2,500 and 50,000 persons.

(d) *Distribution of the Capital Investments by Type of Organization*

All capital investments during the 1966–75 decade are estimated to be expended by local governments (including special districts) or private organizations. In view of the increasing activity in area and regional refuse disposal, it is estimated that about 70 to 75 percent of the total required investment of $1.69 to $1.80 billion will be accounted for by local governments, and about $640 to $730 million by private organizations. In this estimate it is assumed that private organizations will continue to account for about 45 percent of the collection efforts while almost all of the disposal facilities will be established and operated by local governments.

2. SOURCES OF FINANCING

In view of the past investment trends and the demand on the financial resources of local governments for education, highway, water supply, and sewerage investment needs, it is estimated that the capital requirements herein forecast will not be met unless the Federal or State governments underwrite, in one way or another, at least two-thirds of the $1.8 billion share allocated for the investment needs of local governments. Federal financing of municipal refuse collection equipment would obviously place the private entrepreneur at an unfair disadvantage. Therefore, Congress may wish to provide Federal funds for refuse collection equipment only in those cases where adequate service, at a reasonable cost, cannot be provided without such assistance. Federal aid at the level proposed would enable local units of government to maintain their investments at approximately the same level as they were in the 1956–65 decade. However, Federal aid for refuse disposal equipment and facilities would permit local communities to reallocate funds and increase their capital investment in collection equipment needed to improve existing operations and extend service to areas not presently served by public or private systems. The present state of the current refuse collection and disposal operations reflects the strained financial situation of local governments.

The breakdown among the various sources of financing for the capital investments not underwritten by Federal or State governments is estimated to be about the same as presented in the previous discussion under the section "Sources of Financing for These Capital Outlays," on page 200.

In evaluating the portion of the investment needs to be borne by the Federal Government it must be recognized that many small communities, with their limited tax base and income potential, are not able to take advantage of Federal grants, even on a 4-to-1 basis. In addition, the annual expenditures for sanitation other than sewerage,

containing mostly direct operating expenses and excluding debt service payments, might be expected to double on a per capita basis and almost triple on a total dollar expenditure basis as suggested by the extrapolations in exhibit I.

It should also be noted that an increased capital investment of the magnitude proposed in the report would, in addition, add approximately $6 to $8 billion to the total cost of refuse collection and disposal service over the next decade. This results from the fact that additional operating and maintenance expenditures must be incurred in connection with this added investment. The increased cost would most likely be financed from service charges or general tax revenues.

Furthermore, efforts by the Federal Government in research and regulation already begun in the field by the Office of Solid Wastes of the Public Health Service, promise to produce changes in disposal methods under conditions of accelerating technological progress.

The present unsatisfactory conditions existing in the solid wastes field can be improved through efforts made to develop public awareness of the problems and their consequences. Enthusiastic leadership is needed to encourage public support of financial programs designed to improve refuse collection and disposal service. These efforts, coupled with the establishment and enforcement of acceptable standards, the training of operating and management personnel, improved data collection, and increased research in the solid wastes field are needed to provide safe, healthy, and pleasant environments for the citizens of this Nation.

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Chapter 8

Electric Power*

The U.S. electric utility industry has grown from an infant born in the 1880's to a giant ranked the largest in the Nation today. It has expanded at a pace nearly twice that of the overall economy, doubling roughly every 10 years and increasing at an annual compound rate of about 7 percent. Electricity provides over 22 percent of the basic energy needs in the United States today and is expected to supply nearly 28 percent by 1975. Total electric plant investment of all electric utilities in the country, both privately and publicly owned, amounted to approximately $82 billion at the end of 1965.

A. Nature and Composition of Electric Power Facilities

1. DESCRIPTION

An electric power supply system is composed of many interdependent parts that serve three more-or-less distinct major functions—generation, transmission, and distribution. The significance of these functions on cost to the consumer, based on composite national statistics for 1962, is shown in table 1.

TABLE 1.—*Total delivered cost of power, 1962*

[Composition in percent]

	Fixed charges	Operating expenses	Total cost
Generation	28.2	22.8	51.0
Transmission	7.9	2.0	9.9
Distribution	22.8	16.3	39.1
Total	58.9	41.1	100.0

Generating plants fall into five principal types: steamplants (fossil fuel and nuclear), conventional hydroelectric stations, pumped-storage projects, internal combustion units, and gas turbines.

Steamplants generate electricity from the energy in fossil fuels or nuclear sources by heating water to steam and using the steam, under pressure, to drive turbines which convert the energy into electrical form.

Hydroelectric plants develop the water power potential of our rivers by using the energy of falling water to drive turbines that turn the generators.

Pumped-storage plants are a type of hydroelectric development, where low-cost energy produced for the most part at steam-electric

*Prepared by Bureau of Power, Federal Power Commission, with minor editing by committee staff. Acknowledgment is made to Rural Electrification Administration, and American Public Power Association for their assistance in providing information for use in the preparation of this chapter.

generating plants is used during off-peak periods to pump water from one pool to another at a much higher elevation. The water is stored in the higher reservoir until the time of peak loads when it is released back to the lower pool, to generate electricity at a time when its value to the system is at a maximum.

Internal combustion and gas-turbine generators are generally small units that frequently provide power for small systems and are adaptable for emergency and peaking power. Interest in their use for standby purposes has increased significantly during recent months, particularly since the Northeast blackout of November 9, 1965, but their combined capacity presently is only slightly more than 2 percent the total installation in the United States.

The basic energy sources used for electric power generation in the United States over the past 35 years are summarized in table 2.

TABLE 2.—*Sources of electric utility generation—Percentages of total kilowatt-hours, 1930–65*

	1930	1940	1950	1960	1965
Coal	56	54	47	54	54
Natural gas	7	8	14	21	21
Oil	3	4	10	6	6
Water power	34	34	29	19	18
Nuclear	0	0	0	0	(1)
Total	100	100	100	100	100

[1] 0.3 percent.

The geographic distribution of *generating* capacity in the United States is shown in figure 1, which also shows the distribution between hydro and thermal capacity. Figure 2 shows how the efficiency of steam generating units has increased over the past 30 years because of improved technology and the use of larger units with higher temperatures and pressures.

Transmission systems serve the basic function of carrying electricity from the generation area to the load area. The strategic importance of transmission, however, is much greater than is indicated by its 10 percent average share in the overall cost of electricity. Low-cost transmission permits the use of the most economical generation sources at mine-mouth plants or other remote-from-load areas. Adequate interconnections between systems provide the key to large-scale, low-cost generating units; to major savings in capacity due to load diversity; to the sharing of reserve generating capacity; and to the most efficient utilization of existing generating capacity. In short, a good transmission system has a significant influence on the cost of all phases of electric power service.

Transmission voltages in the United States presently in use range from 22 kilovolts to 500 kilovolts, and even higher voltage lines have been built for experimental purposes and are being actively studied. These high voltages permit the movement of large amounts of power over relatively long distances without the high transmission losses associated with lower voltage lines. The capital cost of high-capacity lines is also being reduced as a result of recent technological improvements. Almost all transmission in the United States at present is by alternating current (a.c.), but one 750-kilovolt direct-current (d.c.)

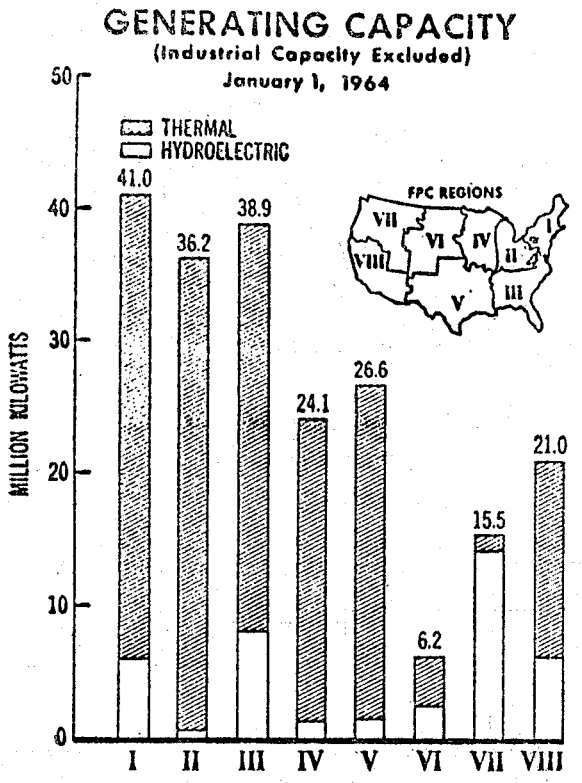

FIGURE 1

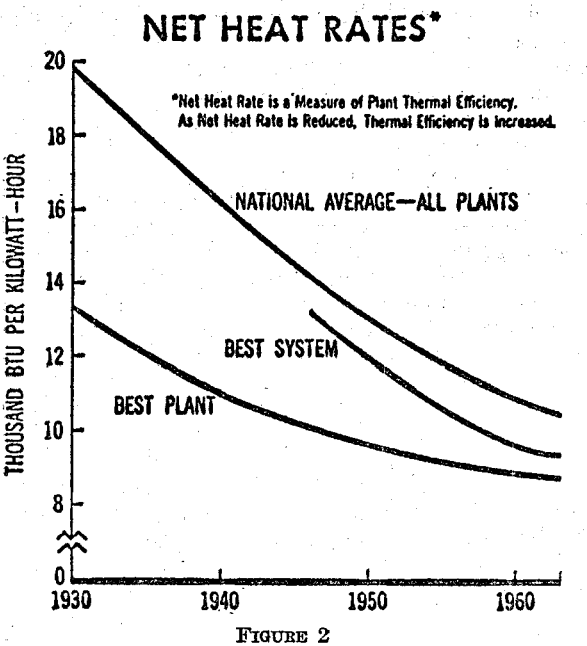

FIGURE 2

line has been contracted for and d.c. transmission may become an important factor in point-to-point movement of power where numerous taps and interconnections are not required.

Distribution is commonly considered to include all of the facilities needed to deliver power from the utility's primary transmission network to the door of the customer.

The cost of distribution is much more dependent on load density than on the size of the system. Many small distribution systems are operated by municipalities and other public or private groups and the physical nature of distribution systems permits these small distributors to operate their systems with a quality of service and at costs which are frequently comparable to those of larger power systems.

At the end of 1965 the total installed electrical generating capacity in the United States was more than 254 million kilowatts. During the year, over 1.15 trillion kilowatt-hours of energy were generated, or the equivalent of about 6,000 kilowatt-hours for every man, woman, and child in the Nation, considering all household, commercial, industrial, and other uses. Household use amounted to nearly 5,000 kilowatt-hours per family in 1965.

Electric utilities in the United States provide service that is among the most reliable to be found anywhere in the world. Many areas go for years without power service interruptions, and recurring outages in any one area are rare. A power system is a complicated mechanism, however, and short duration power failures are caused somewhere in the Nation almost daily by storms, human error, equipment failures, or other factors. Occasionally a local occurrence cascades into a major blackout, such as that experienced in the Northeast on November 9, 1965. As technology improves, and as neighboring systems are more strongly intertied, the likelihood of extended outages decreases. The Federal Power Commission recently established an Industry Advisory Committee on Reliability of Electric Bulk Power Supply, and the committee is making an exhaustive and coordinated study of problems of maintaining service reliability. In addition, almost every utility is constantly checking its own equipment and operating procedures to insure that optimum service is provided.

2. EXISTING ELECTRIC PLANT IN THE UNITED STATES

Table 3 shows the total number of plants and the installed capacity of electric utilities in the United States as of December 31, 1965, with a breakdown by States and regions. The table also shows the distribution between steam, hydro, and internal combustion installations. The generation from these plants is carried to bulk distribution centers by a network of nearly 400,000 miles of high-voltage transmission lines that serve every part of the Nation. About 1 percent of the transmission system is underground. Practically all of the underground lines are located in congested urban areas.

About 5 percent of the total generation in the United States comes from municipally owned plants. A distribution of the generating capacity of these plants by size of city is not readily available, but about half is owned by large municipalities with populations over 100,000. Many small cities own distribution facilities, and many of these own generating plants which, although small, account for nearly half of the national total for all municipally owned plants.

TABLE 3.—*Installed capacity of electric utility generating plants, by States and type (kilowatts), Dec. 31, 1965 (preliminary)*

Division and State	Number of utilities [1]	Number of plants [2]	Total capacity (kilowatts)	Type of plant					
				Hydro		Steam		Internal combustion	
				Number	Capacity (kilowatts)	Number	Capacity (kilowatts) [3]	Number	Capacity (kilowatts)
United States	1,280	3,345	235,677,074	1,248	43,792,160	1,078	188,498,817	1,019	3,386,097
New England	72	266	8,905,995	159	1,242,129	68	7,489,316	39	174,550
Middle Atlantic	65	271	34,117,493	134	4,741,371	111	29,263,938	26	112,184
East North Central	211	526	45,419,398	190	799,841	206	44,143,467	130	476,090
West North Central	430	773	16,510,939	84	2,940,313	215	12,236,025	474	1,334,601
South Atlantic	117	333	34,989,257	143	4,994,197	140	29,766,416	50	228,644
East South Central	35	111	24,104,470	47	4,489,359	46	19,594,137	18	20,974
West South Central	144	318	25,090,335	38	1,664,350	136	22,830,079	144	595,906
Mountain	123	362	12,994,522	182	5,561,572	82	7,117,500	98	315,450
Pacific contiguous States	54	327	32,628,011	255	17,273,353	58	15,291,604	14	63,054
Pacific noncontiguous States	29	58	916,654	16	85,675	16	766,335	26	64,644
New England:									
Maine	15	68	875,113	44	344,257	7	465,630	17	65,226
New Hampshire	8	30	761,212	23	394,810	6	363,386	1	3,016
Vermont	12	64	303,885	49	185,690	7	97,750	8	20,445
Massachusetts	22	62	4,144,534	26	181,922	27	3,906,429	9	56,183
Rhode Island	6	10	427,125	2	2,100	5	405,625	3	19,400
Connecticut	9	32	2,394,126	15	133,350	16	2,250,496	1	10,280
Middle Atlantic:									
New York	33	178	16,941,042	123	3,965,310	42	12,916,560	13	59,172
New Jersey	8	24	6,417,002	3	344,741	20	6,066,066	1	6,195
Pennsylvania	24	69	10,759,449	8	431,320	49	10,281,312	12	46,817
East North Central:									
Ohio	38	77	12,037,523	1	2,250	57	11,965,562	19	69,711
Indiana	25	49	8,161,296	7	29,155	35	8,105,778	7	26,363
Illinois	46	83	12,479,227	9	38,679	47	12,307,861	27	132,687
Michigan	53	149	8,279,097	74	357,555	37	7,738,944	38	182,598
Wisconsin	49	168	4,462,255	99	372,202	30	4,025,322	39	64,731
West North Central:									
Minnesota	77	165	3,095,869	33	149,852	51	2,718,865	81	227,152
Iowa	96	183	2,600,688	13	135,890	46	2,132,025	124	332,773
Missouri	64	100	4,179,751	6	800,600	37	3,186,090	57	193,061
North Dakota	12	39	740,872	1	400,000	16	296,800	22	44,072
South Dakota	32	60	1,474,188	8	1,210,496	11	184,750	41	78,942
Nebraska	69	103	1,592,747	20	238,025	19	1,193,950	64	160,772
Kansas	80	123	2,826,824	3	5,450	35	2,523,545	85	297,829

South Atlantic:									
Delaware	4	12	602,290			9	591,050	3	11,240
Maryland	11	20	3,675,893	2	493,680	14	3,161,040	4	21,173
District of Columbia	2	3	536,750	1	3,000	2	533,750		
Virginia	20	49	5,121,280	26	638,636	14	4,451,111	9	31,533
West Virginia	10	19	3,608,450	9	100,960	10	3,507,490		
North Carolina	26	77	6,345,325	51	1,726,558	18	4,606,810	8	11,957
South Carolina	10	45	2,696,019	25	936,135	17	1,758,370	3	1,514
Georgia	6	39	4,157,585	26	1,056,260	12	3,099,325	1	2,000
Florida	28	69	8,245,665	3	38,968	44	8,057,470	22	149,227
East South Central:									
Kentucky	9	23	6,092,183	5	540,614	16	5,543,542	2	8,027
Tennessee	5	34	8,462,148	26	1,993,200	6	6,468,650	2	298
Alabama	5	28	8,319,906	16	1,955,545	10	6,362,385	2	1,976
Mississippi	16	26	1,230,233			14	1,219,560	12	10,673
West South Central:									
Arkansas	14	29	2,015,176	11	869,340	8	1,101,050	10	44,786
Louisiana	31	59	4,259,498			26	4,071,899	33	187,599
Oklahoma	36	65	3,094,427	5	355,400	23	2,603,715	37	135,312
Texas	63	165	15,721,234	22	439,610	79	15,053,415	64	228,209
Mountain:									
Montana	8	26	1,396,480	20	1,261,830	5	133,650	1	1,000
Idaho	10	43	1,255,320	38	1,250,930			5	4,390
Wyoming	16	45	899,750	16	212,540	9	663,750	20	23,460
Colorado	32	78	1,986,791	28	265,257	25	1,642,200	25	79,334
New Mexico	16	30	1,791,798	2	24,630	16	1,719,129	12	48,039
Arizona	10	37	3,575,224	13	1,665,040	13	1,869,483	11	50,701
Utah	24	80	801,069	57	209,425	9	545,772	14	45,872
Nevada	7	23	1,288,090	8	681,920	5	543,516	10	62,654
Pacific contiguous States:									
Washington	20	61	9,330,105	50	9,090,301	7	236,640	4	3,164
Oregon	12	67	3,188,747	53	2,992,092	10	191,635	4	5,020
California	22	199	20,109,159	152	5,190,960	41	14,863,329	6	54,870
Pacific noncontiguous States:									
Alaska	24	43	221,587	14	82,325	7	89,110	22	50,152
Hawaii	5	15	695,067	2	3,350	9	677,225	4	14,492

[1] Total incudes 110 duplications because of utilities having generating plants in more than 1 State.

[2] Each type of prime mover at combination plants is counted as a separate plant.

[3] Includes 926,100 kilowatts of nuclear-fueled steam capacity, and 1,359,081 kilowatts of gas turbine capacity.

A precise summary of electric power facilities by age is not available, but inasmuch as the capacity, nationwide, doubles approximately every decade, it can be presumed that about half of the total current installation (capacity wise) is less than 10 years old, about one-fourth is 10 to 20 years old, and about one-fourth is more than 20 years old. These percentages apply to capacity, but not to the number of installations. A single plant of the type being constructed today may have more capacity than the combined installation at 100 plants built 30 or 40 years ago. Thus a high percentage of the number of plants in operation today are more than 20 years old. There are a few plants still in operation that were constructed shortly after the turn of the century.

Table 4 shows the distribution of generation in the United States by type of ownership for 1964 and 1965.

TABLE 4.—*Electric utility net generation, United States, 1964–65*

[Millions of kilowatt-hours]

	1964	1965
Total	983,990	1,054,790
Privately owned	756,183	809,535
Publicly and cooperatively owned	227,807	245,255
Municipal	49,600	49,813
Federal	129,936	145,225
Co-ops, power districts, State projects	48,271	50,217

B. COSTS AND USER CHARGES

1. CONSTRUCTION COST AND OPERATING COST

Construction costs for electric power facilities vary widely depending upon type of motive force, location, size, and a myriad of other factors. Average costs are therefore reasonably reliable only when they are applied to a large group of facilities within a relatively large geographical area. On a national basis, and considering all types and sizes of plants currently being constructed, steam generating plant construction costs average about $130 per kilowatt at today's prices. Hydro plants cost an average of about $250 per kilowatt, and internal combustion plants about $100 per kilowatt. When these costs are weighted for the various types of plant, the national average cost for current installations is in the neighborhood of $150 per kilowatt. Transmission and distribution costs, combined, cost somewhat more per kilowatt, on the average, than generation costs, so the total cost of constructing facilities to deliver power to the consumer, including miscellaneous costs, approximately $400 per kilowatt of required capacity. The current average cost of electrical energy to all consumers (residential, commercial, and industrial) is about 1.6 cents per kilowatt-hour.

About 41 percent of the total cost of delivered energy is attributable to operation and maintenance costs, including fuel. This percentage has been gradually decreasing, and may possibly fall to about 38 percent by 1975.

2. USER CHARGES

Customer charges for electric service generally involve two components—a demand charge and an energy charge. The demand charge relates to the kilowatts of capacity that the utility agrees to make available to the customer upon demand, or within the limits of some specified demand schedule. The energy charge is related to the kilowatt-hours of energy that the customer uses. Residential bills generally do not include a demand charge, per se, but many utilities have a minimum charge for maintaining a service connection.

Electric utilities provide what is essentially a monopolistic service. The pattern of assigned service areas and controlled rates has evolved as a matter of mutual interest of utilities and legislative bodies in assuring optimum service to all customers at minimum practicable prices. The statutes of 46 States provide for public service commissions with varying degrees of statewide jurisdiction over investor-owned electric utilities. These commissions typically regulate rates for retail sales, standards of service, issuance of securities, and accounting. Local regulation—directly and by franchise—is a factor in Minnesota, South Dakota, and Texas, where statewide regulations do not exist. In Nebraska, all electric utilities are publicly owned.

The interstate wholesale rates and services of investor-owned utilities are subject to the jurisdiction of the Federal Power Commission. The Commission's jurisdiction also extends to accounting, some compulsory interconnections, utility mergers, control of interlocking directorates, and, in some instances, issuance of securities by or of public utilities engaged in interstate commerce of electric energy.

Rates for all types of electric service by investor-owned utilities are based on the premise that revenues will: (1) permit recovery of capital investment during the useful life of the facilities, (2) cover annual operation, maintenance, and other costs, and (3) permit a reasonable return on the investor's capital. While electric rates are geared to the cost of doing business, rate regulation has not limited the incentive of utilities to increase their profits by providing increased service at the lowest possible cost. Experience has demonstrated that the electric power industry has been able to keep down cost to consumers even when the prices of almost all other basic services were increasing.

According to the BLS Consumer Price Index (based on 1957–59 prices equals 100) the index of electricity prices was 102 in the first quarter of 1966 compared with 102.1 a year earlier; during the same period the Consumer Price Index for all commodities and services increased from 108.9 to 111.5. Since 1945 the price index for electricity has risen about 6 percent while prices of all commodities have increased about 85 percent.

C. Trend in Capital Outlays

Table 5 summarizes capital expenditures of the industry for the period 1948 to 1966. The data, which were taken from *Electrical World* surveys, vary in coverage from roughly 84 to 92 percent of the entire industry.

TABLE 5.—*Electric utility industry capital expenditures, contiguous United States*

[In millions of dollars]

	Generation	Transmission	Distribution	Miscellaneous	Total (partial coverage) [1]	Total (full coverage)
1948	1,103	400	1,075	84	2,662	3,000
1949	1,410	400	1,190	93	3,093	3,500
1950	1,275	425	1,127	109	2,936	3,300
1951	1,344	504	1,089	131	3,068	3,500
1952	1,925	577	1,118	118	3,738	4,300
1953	2,088	647	1,200	127	4,062	4,700
1954	1,939	666	1,288	122	4,015	4,700
1955	1,548	571	1,343	161	3,623	4,300
1956	1,479	598	1,518	186	3,781	4,400
1957	2,234	747	1,566	199	4,746	5,500
1958	2,582	764	1,373	187	4,906	5,600
1959	2,369	708	1,413	180	4,669	5,300
1960	2,226	715	1,565	183	4,690	5,300
1961	2,114	764	1,550	180	4,608	5,200
1962	1,693	792	1,593	193	4,271	4,700
1963	1,721	837	1,568	230	4,357	4,800
1964	1,814	1,047	1,688	252	4,801	5,200
1965	1,941	1,181	1,861	269	5,254	5,700
1966 [2]	2,599	1,518	2,019	316	6,452	7,000

[1] Figures may not add due to rounding.
[2] Prospective.

Source: First 5 columns are from Electrical World Surveys (courtesy of Electrical World) and represent partial coverage. Last column represents FPC estimates of full coverage based on the Electrical World figures.

About three-fourths of all electric power facilities in the United States are controlled by investor-owned private utilities. The other one-fourth is about evenly divided between Federal developments and the combination of non-Federal public facilities and cooperatives. Table 6 shows the distribution of ownership for 1944 and 1964.

TABLE 6.—*Ownership of electric generating facilities*

	Percent of total capacity	
	1944	1964
Investor-owned utilities	81	76
Cooperatives		1
Public	19	[1] 23
Municipal	(7)	(7)
State	(2)	(4)
Federal	(10)	(13)
Total	100	100

[1] The detail does not add to the total due to rounding.

1. INVESTOR-OWNED SYSTEMS

The 480 investor-owned systems in the United States today reflect the merger and consolidation of some 4,000 separate investor-owned systems and some 1,000 additional municipal systems which were once in existence. Approximately 320 of these 480 companies are vertically integrated systems, generating most of the power they distribute. These systems account for 70 percent of the total electricity generated by the entire industry, public and private. Most of the other 160 investor-owned systems are primarily engaged in distribution.

Until 1961, investor-owned utilities obtained the major portion of their funds for construction from new security issues. Since the

early 1950's, however, internally generated funds—retained earnings, depreciation and amortization reserves, and deferred taxes—have supplied an increasing share and in 1962 nearly 60 percent of the investor-owned segment's construction funds were internally generated. Amortization and depreciation, which supplied 40 percent of construction funds in 1962, has replaced new debt issues as the most important single source of funds.

Table 7 shows the shifts which have taken place in the major sources of construction funds since 1950.

TABLE 7.—*Sources of construction funds, investor-owned electric utilities, 1950–62*

Source	1950	1954	1958	1962
Security issues:	*Percent*	*Percent*	*Percent*	*Percent*
Common stock	24.6	17.5	14.5	13.8
Preferred stock	9.5	6.7	6.6	4.4
Debt	33.0	41.6	38.2	22.7
Total securities	67.1	65.8	59.3	40.9
Internal funds:				
Retained earnings	7.8	6.2	8.6	14.0
Deferred taxes		4.5	5.9	3.9
Depreciation and amortization	25.1	23.5	26.2	41.2
Total internal funds	32.9	34.2	40.7	59.1
Total	100.0	100.0	100.0	100.0
	Millions	*Millions*	*Millions*	*Millions*
Total construction funds	$1,920	$2,950	$3,794	$3,360

The overall capital structure of investor-owned systems consists of approximately 53 percent debt, 10 percent preferred stock, and 37 percent common stock and retained earnings.

Table 8, which traces the composite of the capital structure of the investor-owned segment for selected years from 1964 to 1962, indicates that there has been little change in the capital structure since the mid–1950's.

Approximately 11 percent of the revenues of investor-owned electric utilities in 1962 were paid in Federal income taxes on the earnings of equity capital. Revenues must also cover State and local taxes, which together approximate the magnitude of Federal income taxes. The aggregate of all taxes paid by the investor-owned sector in 1962, exclusive of provisions for deferred income taxes, was about 22 percent of total revenues.

TABLE 8.—*Composite capital structure investor-owned electric utilities, 1946–62*

[In percent]

Year	Common stock	Earned surplus	Preferred stock	Debt
1946	32.1	6.3	15.2	46.4
1950	29.8	7.1	13.6	49.5
1954	28.7	7.7	12.4	51.2
1958	26.7	8.5	11.3	53.5
1962	26.8	10.2	10.2	52.8

2. FEDERAL SYSTEMS

Federal power agencies are important contributors to the Nation's electric power supply. Federal power is produced at approximately 125 hydroelectric projects which are part of Federal multipurpose water resource developments, and at steam plants of the Tennessee Valley Authority (TVA).

Nearly all Federal power is marketed by TVA and four Department of the Interior agencies—Bureau of Reclamation, Bonneville Power Administration, Southwestern Power Administration, and Southeastern Power Administration. As of January 1, 1964, the Interior Department was the marketing agency for the power developed at 95 projects having an installed capacity of 13,900 megawatts.

With the exception of TVA, capital funds for Federal systems are supplied entirely by congressional appropriations. Since 1959, TVA has been empowered to obtain funds in the private capital markets by the issuance of revenue bonds. The Government's investment in TVA is junior to the revenue bonds sold to the public. Since the 1959 self-financing act, TVA has been required to pay the U.S. Treasury a "return" or "dividend" on the Government's investment equivalent to the average rate of interest paid by the Treasury on its outstanding marketable debt. TVA is also required to repay $1 billion of the appropriated investment of $1.2 billion within the next half century.

Federal systems are not subject to Federal and State income taxes or to local property taxes. TVA, however, makes substantial payments in lieu of taxes to State and county governmental units.

There is not complete uniformity in the repayment requirements for Federal projects or in earnings standards for power sold from these projects. Normally, payments are required for the equivalent of an interest assessment and for amortization of the project investment allocated to power. Interest on new projects is currently computed at 3⅛ percent per annum, the average of the interest rate on all outstanding long-term securities of the United States. This figure has gradually risen as the interest rate paid by the Government on new issues—now over 4 percent—has increased.

3. STATE AND LOCAL PUBLIC AGENCIES

Local public ownership began early in the industry's development, when numerous municipal systems were organized to provide electricity to previously unserved areas. There were more than 700 public systems in 1900 and over 3,000 by the early 1920's, compared with approximately 2,100 today.

Many types of public agencies own electric generation, transmission, or distribution facilities, or combinations thereof. They vary greatly in size, ranging from small towns to the city of Los Angeles. Although it is not a common occurence, a few counties, such as Crisp County, Ga., and three counties in the TVA area, maintain their own systems. However, the most common forms of public power entities, other than municipal systems, are special utility districts (exemplified by the numerous public utility districts of Nebraska, Oregon, and Washington), municipal utility districts (such as the Sacramento Municipal Utility District in California), irrigation districts (some of which, such as the Imperial Irrigation District in California, also maintain electric

utility systems) and the various kinds of State "authorities" (such as the Grand River Dam Authority in Oklahoma, the Colorado River Commission of Nevada, the Power Authority of the State of New York, and the Arizona Power Authority).

The statutory and constitutional framework within which these public entities were created has tended to maintain their separate identities, and there is great diversity in the nature of their operations. Many municipalities and other local public agencies generate their own power requirements in varying degree, while others purchase power from Federal, investor-owned, cooperative, or other local public systems, and sometimes from a combination of such suppliers. A few are largely confined to the generating and transmission functions. An example is the Power Authority of the State of New York, which sells at wholesale the power it generates at its two big hydroelectric projects at Niagara Falls and the St. Lawrence Seaway.

The great bulk of the local public agency systems are municipally owned and serve only the areas of the municipalities themselves. In a relatively few instances (e.g., Cleveland, Ohio), a municipal system and an investor-owned system serve within the same municipality. However, territorial competition between municipal systems and others is usually confined to the expansion of municipal boundaries, which may bring competition to fringe areas previously served by cooperatives or investor-owned systems.

The local public agency systems generally obtain their capital investment funds from power revenues and by selling debt securities in the public market. In the past, such securities were often general credit obligations of the municipality, county or State. More recently, however, the emphasis has been on revenue bonds issued by the utility system itself, payable from revenues alone and not backed by the general credit of the local government or by a lien on physical properties.

Local public agencies are traditionally exempt from Federal income tax and generally not subject to State income tax. In most jurisdictions, they are also not subject to real property or other local taxes. However, by statute or ordinance in some jurisdictions and by agreement or practice in others, most local public agencies make substantial payments in lieu of taxes to their own local governments and often make large additional contributions to such governments. Many of them also make payments in lieu of tax payments to State and county governments. In addition, many municipal systems provide power free or at reduced rates to the city government for street lighting, water pumping, and other municipal uses.

Interest on the debt securities of such local agencies is exempt from Federal income tax and, in most jurisdictions, from State income tax, so that their debt securities command more favorable terms than debt securities issued by comparable investor-owned electric utility systems.

4. RURAL ELECTRIC COOPERATIVE SYSTEMS

The electric cooperative became a significant part of the electric industry beginning in the middle 1930's. Prior to that time, the investor-owned segment of the industry has extended electric service to only about 10 percent of the farms of the country.

The Rural Electrification Act of 1936 was designed to stimulate farm electrification through low cost loans by the Rural Electrification

Administration of the U.S. Department of Agriculture, originally established in 1935 by Executive order of President Roosevelt. The REA program has been extremely successful. Today, as a result of the REA program and the expansion of the investor-owned companies' rural electrification programs, 98 percent of the Nation's farms are electrified. There are now almost 1,000 cooperatives participating in the REA program, serving 50 percent of the consumers in the Nation's rural areas. Although REA may make loans to investor-owned and public systems, it appears that the cooperatives have come to be the preferred vehicle for the extension of rural electrification with Federal funds.

The vast majority of cooperatives are merely distributors and purchase all of their power at wholesale from the Federal power marketing agencies or investor-owned utilities. However, some groups of distribution cooperatives have formed generating and transmission cooperatives to generate a part or all of their electric power requirements. These "G and T" type cooperatives now supply about 15 percent of the requirements of the cooperative segment. They are also financed largely by REA.

The Rural Electrification Administration initially limited its loans to cooperatives to serve communities of not more than 1,500 persons which were without central station service. With the population shifts of the last three decades, some cooperatives now serve sizable communities. However, the cooperative systems typically serve areas of low customer density which, of course, increases the cost of distribution. Cooperatives average about 3 customers per mile of line compared with 20 customers per mile for the industry as a whole.

Except in a few States, the cooperative systems are not granted exclusive franchises for their service areas, and there is much competition between them and other systems for service to new loads. The annexation by municipalities of suburban areas initially served by cooperatives is a major cause of territorial competition. In some areas competition has led to the construction of duplicate facilities. In other areas, there are formal or informal arrangements which permit both systems to minimize the cost of service to their respective customers.

Only a small portion of the capital requirements of cooperative systems is obtained from their membership. The remainder is provided largely by long-term mortgage loans from the Rural Electrification Administration. Interest on such loans is authorized by law at 2 percent per annum.

Rates for service of cooperative systems are designed to cover costs and amortization requirements of REA loans and to provide for contingencies. Payments by consumers in excess of the cost of supplying electric energy are deemed to be capital. This capital is commonly credited to each consumer on a patronage basis and is retired on a revolving basis when the financial condition of the cooperative permits. Most cooperative systems do not return all such capital, at least until a desired reserve level has been accumulated.

Under present law the courts have held the cooperatives not to be liable for Federal and State income taxes. Most cooperatives do, however, pay State and local taxes other than income taxes.

Capital outlays by type of ownership

Table 9 shows the pattern of estimated electric utility construction expenditures for selected years.

TABLE 9.—*Estimated electric utility construction expenditures*

[Billions of dollars]

Year	Private	Federal	Municipal	States, cooperatives and other	Total
1955	3.0	0.4	0.5	0.4	4.3
1960	3.4	.4	.8	.7	5.3
1965	4.1	.5	.5	.6	5.7

Source: Estimated by FPC.

D. NEEDS AND PROSPECTIVE CAPITAL OUTLAYS

It is reported that electric utilities expect to invest over $6 billion in new facilities during 1966. This rate of expenditure is nearly double the annual rate that prevailed 10 years ago, and this accelerating trend will have to continue if the production goals anticipated for 1975 are to be met. Projections of the magnitude of future industry growth are difficult, because of the potentials that exist for improved efficiencies in delivering power to the consumer and the possibilities for new uses of electric energy. The estimates are based on a continued improvement in technology as indicated by recent trends, and on population growth, obsolescence, and other factors that are consistent with current general practice. The figures are based on the assumption that new power facilities will be designed and built to provide optimum aesthetic values, considering costs and other limiting factors. They do not anticipate extensive replacement for aesthetic reasons of facilities that have remaining useful life.

On the basis of the general criteria discussed above, it is estimated that the country's electric utilities will need approximately 315 million kilowatts of generating capacity by 1970 and 415 million kilowatts by 1975. Allowing for retirements of generating capacity in the future because of age or obsolescence, total capacity additions during the years 1966 through 1970 will have to be about 85 million kilowatts, and additions for 1971 through 1975 will need to be about 110 million kilowatts. Yearly capacity additions will range from nearly 15 million kilowatts in 1966 to 20 million in 1970 and 25 million in 1975.

Utilizing the preceding forecasts of capacity additions, total construction expenditures in the 10-year period would probably be in the neighborhood of $75 billion without any allowance for inflation.

Assuming a continuation of the ownership patterns shown in table 6, but with some adjustments to reflect the type of facilities owned by each segment of the industry, total electric utility construction

expenditures in the years 1966, 1970, and 1975 distributed by type of ownership may be estimated as follows:

TABLE 10.—*Projected electric utility financing requirements*

[Billions of dollars]

Year	Private	Federal	Municipal	States, co-operatives and other	Total
1966	5.0	0.7	0.7	0.6	7.0
1970	5.5	.8	.9	.6	7.8
1975	6.3	.9	1.1	.7	9.0

For the publicly owned segment the principal sources of capital funds are revenue bonds, *retained earnings*, and borrowing from national, State, and municipal treasuries. Cooperatives have traditionally borrowed from the Federal Treasury, but there are indications that they will enter the private money market to obtain some of the capital that will be needed during the next decade. The investor-owned utilities draw on their internal sources as well as on borrowing from insurance companies, pension plans, savings banks, and private investors.

The industry as a whole has had no difficulty in raising the capital it has needed for its continuing expansion. There seems no reason to doubt that the industry will be able to obtain sufficient funds to finance the construction program required during the next decade.

CHAPTER 9

Gas Distribution Systems*

INTRODUCTION

In 1966 the gas distribution industry celebrates its 150th year of service; the first gas distribution system was established in Baltimore in 1816, just 2 years after the famous defense of Fort McHenry and the writing of the Star-Spangled Banner. The distribution sector of the gas industry in the United States today includes 773 municipal and 728 investor-owned systems. There are no State-owned or cooperative gas distribution systems, while the only Federal systems are limited to serving military installations. (The latter are outside the scope of this study.) Although municipal systems are more numerous than investor-owned systems, they account for only between 5 and 10 percent of the gas distribution business in terms of gas distribution plant, number of customers served, or volume of gas sold.[1]

About 80 percent of the Nation's population live in areas served by gas distributors. Gas use has grown rapidly during the past 20 years as a result of service being extended to more and more communities, population growth, and increased use per customer The demand for gas is expected to continue increasing in the years ahead. To meet the demand, substantial additional investment will be required in distribution systems as well as in natural gas transmission pipelines and gas production.

A. NATURE AND COMPOSITION OF FACILITIES

1. DESCRIPTION OF FACILITIES

The gas industry in the United States is comprised of three branches—producers, pipeline companies, and distribution companies. Ninety-eight percent of the industry's customers are supplied with natural gas [2] most of which is produced in the Southwest. The remaining 2 percent of the customers receive manufactured gas produced by distribution companies or some mixtures of manufactured and natural gas or LP gas. By contrast, in 1938 the industry supplied only 40 percent of its customers with natural gas.

In addition to supplying gas to pipelines and distributors, the producers of natural gas use some of their own gas and sell some directly to consumers (mostly for industrial purposes). About one-quarter of

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[1] Based upon data in *Gas Facts* (New York: American Gas Association, 1965); letter from I. S. Schwimmer ssistant director, Bureau of Statistics, American Gas Association, Mar. 29, 1966, and other AGA records.

[2] See: R. J. Rutherford, "Gas Industry Scores Again on All Points," *American Gas Association Monthly*, (issue of January 1966), pp. 2–5. At the end of 1965 gas utilities served 38,071,600 customers; 37,310,300 of these customers were served with natural gas.

the natural gas consumed in this country is delivered directly to ultimate consumers and is not handled by pipelines or distributors.[3]

Natural gas pipelines carry gas from producing areas to major industrial and population centers in all parts of the country. The major portion of the gas carried by pipelines is destined for delivery to distribution systems, but pipelines also make sales directly to consumers. About 5½ percent of the gas customers (exclusive of those supplied by producers as noted above) receive gas directly from pipeline companies; these sales account for about 20 percent of the gas utility and pipeline sales.[4]

The distribution systems provide most of the deliveries to ultimate consumers after having received supplies at the city gate.[5]

For statistical purposes, the American Gas Association makes the following classification of companies:

A company classified as a gas distribution utility is one which obtains the major portion of its gas operating revenues from the operation of a retail gas distribution system and which operates no transmission system other than incidental connections within its own system or to the system of another company. For purposes of A.G.A. statistics, a distribution company obtains at least 95 percent of its gas operating revenues from sales to ultimate customers (residential, commercial, industrial, etc.) and classifies at least 95 percent of gas mains (other than service pipe) as distribution.

A company classified as an integrated gas utility is one which obtains a significant portion of its gas operating revenues from the operations of both a retail gas distribution system and gas transmission system. For purposes of A.G.A. statistics, an integrated company obtains less than 95 percent but more than 5 percent of its gas operating revenues from either its retail or transmission operations or does not meet the classification of mains established for distribution companies.[6]

Statistics on the gas distribution industry as used in this chapter include data on distribution companies and integrated companies as defined above; where distribution and integrated company data are not available, statistics including data on natural gas pipelines are used to illustrate trends. In terms of capital plant the natural gas pipeline companies account for about 40 percent of the gas utility and pipeline company plant; as shown in table 1, this percent has been fairly constant since 1957.

TABLE 1.—*Natural gas pipeline company utility plant as a percent of gas utility and pipeline company plant*

Year	Percent	Year	Percent
1954	35.9	1960	41.6
1955	37.7	1961	40.7
1956	38.3	1962	41.4
1957	39.9	1963	40.2
1958	40.2	1964	40.6
1959	40.8		

Source: Based on data in *Gas Facts* (New York: American Gas Associates, 1965).

[3] The Bureau of Mines shows 1964 natural gas consumption at 15.5 trillion cubic feet. American Gas Association indicates that sales by pipelines and gas utilities plus use of gas by combination gas and electric utilities for electric generation amounts to about 11.3 trillion cubic feet of 1,032 B.t.u. gas. See: U.S. Bureau of Mines *Minerals Yearbook: 1964* (Washington: U.S. Government Printing Office, 1965) and *Gas Facts*, *op. cit.*

[4] Based on data in *Gas Facts*, *op. cit.* and Schwimmer, *op. cit.*

[5] For further detail see: Alfred M. Leeston, John A. Crichton, and John C. Jacobs, *The Dynamic Natural Gas Industry* (Norman, Okla.: University of Oklahoma Press, 1963) pp. 171–183, and *Natural Gas: A Study in Industry Pioneering* (New York: American Gas Association, 1962.)

[6] Schwimmer, op. cit.

Service to customers of gas distribution systems is classified as residential, commercial, industrial or other. Table 2 shows by class of customer the number of customers, therms [7] sold and revenues received for 1964 and 1965.

TABLE 2.—*Number of customers, therms sold, and revenues received by class of service (all utility and pipeline companies), 1964 and 1965*

	1965	1964	Percent change
Customers (annual average):			
Residential	34,345,500	33,551,200	+2.4
Commercial	2,806,400	2,712,200	+3.5
Industrial	168,200	159,400	+5.5
Other	41,200	40,500	
Total	37,361,300	36,463,300	+2.5
Sales (thousands of therms):			
Residential	40,400,500	38,696,900	+4.4
Commercial	13,839,600	12,734,900	+8.7
Industrial	61,236,600	59,120,300	+3.6
Other	5,368,800	5,360,300	
Total	120,845,500	115,912,400	+4.3
Revenues (in thousands of dollars):			
Residential	4,043,705	3,894,870	+3.8
Commercial	1,080,202	998,386	+8.2
Industrial	2,108,849	2,048,527	+2.9
Other	183,986	190,902	
Total	7,416,742	7,132,685	+4.0

Source: Rutherford, *op. cit.*

Residential service applies to customers supplied with gas by individual meter in a single-family dwelling or in an individuals apartment or to not over four households served by a single meter in a multifamily building. Residential customers use gas for space heating, cooking, water heating, clothes drying, incinerators, and more recently, air conditioning. Commercial service includes service to customers primarily engaged in wholesale or retail trade, agriculture, forestry, fisheries, transportation, communication, sanitary services, finance, insurance, real estate, personal services, service to multifamily buildings, et cetera. Industrial service covers sales to customers engaged primarily in a process which changes raw or unfinished materials into another form or product. Other services include sales to governmental agencies for illumination of public places and sales to public authorities under special agreements.[8]

A measure of the service rendered to consumers is indicated by the use of gas per customer of distribution and integrated companies as shown in table 3.

Most of the gas used by residential customers is for space heat; [9] this results in a winter seasonal peak for the gas industry unless some other summer use can be found for gas. Use of storage facilities near markets and interruptible sales to large industrial customers help

[7] A therm is 100,000 British thermal units; a British thermal unit is the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit. The average natural gas sold by utilities has a heating value of about 1,030 to 1,035 B.t.u. per cubic foot. Manufactured gas has about half of the heating value of natural gas.

[8] *Gas Facts* (New York: American Gas Association, Inc., 1965) pp. 240-241.

[9] *Projected Gas Utility and Pipeline Industry Statistics:* 1965-75 (New York: American Gas Association August 1965) shows residential heating for 1964 accounted for 25,640,000,000 therms and other residential uses accounted for 13,057,000,000 therms.

TABLE 3.—*Use per customer of natural gas from distribution and integrated companies by State and class of service, 1964*

[Therms per customer—Annual]

	Residential	Commercial	Industrial	Other	All classes
United States	1,156.5	4,733.6	261,588.3	121,442.2	2,691.5
New England	662.3	2,470.2	36,228.3	32,375.0	1,002.8
Connecticut	691.1	2,460.7	57,611.1	(1)	1,174.7
Maine					
Massachusetts	658.2	2,418.5	32,321.4	26,857.1	952.1
New Hampshire	752.3	2,545.5	17,500.0	3,000.0	963.5
Rhode Island	615.7	2,878.4	28,187.5	(1)	1,027.2
Vermont					
Middle Atlantic	847.2	2,935.3	131,320.0	16,400.0	1,509.1
New Jersey	721.0	1,967.4	85,500.0	(1)	1,146.5
New York	662.0	2,326.0	47,923.1	13,986.3	983.7
Pennsylvania	1,262.6	5,357.8	315,935.8	21,500.0	2,711.5
East North Central	1,552.3	6,077.0	273,457.6	39,205.5	3,030.3
Illinois	1,321.5	5,901.7	164,211.7	53,000.0	2,476.9
Indiana	1,373.0	4,394.8	621,925.9	26,750.0	3,975.8
Michigan	1,661.3	5,878.1	202,179.4	(1)	2,926.0
Ohio	1,884.9	7,357.2	563,600.0	22,060.6	3,511.9
Wisconsin	1,170.3	4,782.8	184,263.2	(1)	2,661.5
West North Central	1,523.7	6,398.7	264,168.5	413,000.0	3,659.6
Iowa	1,536.0	6,635.5	502,875.0	1,016,000.0	3,781.1
Kansas	1,564.8	5,500.0	360,281.2	(1)	3,975.3
Minnesota	1,535.0	7,284.2	272,825.0	298,000.0	4,004.1
Missouri	1,480.9	6,217.3	231,325.0	231,000.0	2,905.0
Nebraska	1,553.9	5,701.7	145,653.8	303,500.0	4,516.4
North Dakota	1,461.9	9,615.4	245,000.0	(1)	2,962.0
South Dakota	1,470.3	8,493.8	349,000.0	39,000.0	3,744.8
South Atlantic	991.8	4,006.7	250,247.9	18,428.6	2,314.8
Delaware	815.9	2,738.1	520,000.0	(1)	1,659.6
District of Columbia	872.6	3,455.1	5,888.9	6,333.3	1,209.8
Florida	280.7	4,906.4	380,750.0	5,600.0	1,312.8
Georgia	1,128.7	5,177.8	224,435.9	32,250.0	2,806.5
Maryland	945.2	2,292.1	100,280.0	9,000.0	1,443.4
North Carolina	927.0	3,233.0	234,052.6	87,000.0	3,697.9
South Carolina	775.5	3,569.5	573,428.5	4,800.0	3,931.9
Virginia	929.5	3,760.9	182,000.0	45,300.0	1,731.8
West Virginia	1,653.9	5,346.8	1,076,833.3	18,200.0	3,805.7
East South Central	1,183.8	5,264.7	354,285.7	43,306.5	2,755.2
Alabama	973.9	5,175.3	504,800.0	2,500.0	2,246.7
Kentucky	1,511.6	4,940.9	401,875.0	38,733.3	2,577.2
Mississippi	988.1	4,157.9	214,857.1	49,071.4	2,523.5
Tennessee	1,205.5	6,555.0	358,176.4	72,736.8	3,965.5
West South Central	985.8	3,821.2	259,608.4	134,688.9	3,259.6
Arkansas	1,210.9	4,470.6	699,727.0	254,000.0	6,029.0
Louisiana	934.7	3,599.3	261,814.8	91,000.0	2,127.0
Oklahoma	1,135.9	4,731.0	290,277.0	169,000.0	3,157.2
Texas	932.5	3,499.0	211,187.5	140,909.1	3,251.8
Mountain	1,460.5	6,019.8	419,508.7	100,724.1	3,664.5
Arizona	853.5	4,483.1	153,266.6	116,571.4	2,027.2
Colorado	1,562.7	6,906.8	572,166.6	358,000.0	2,996.8
Idaho	1,141.8	4,988.0	343,250.0	7,000.0	4,511.9
Montana	1,787.1	9,117.2	442,333.3	(1)	4,754.9
Nevada	949.3	9,714.3	1,947,000.0	(1)	5,910.6
New Mexico	1,434.5	5,794.1	280,315.7	87,800.0	5,194.3
Utah	2,198.3	3,191.0	1,301,250.0	(1)	4,822.3
Wyoming	1,780.6	7,229.9	837,500.0	44,666.7	4,895.9
Pacific	1,054.0	5,106.1	578,820.3	26,761,000.0	3,160.1
Alaska	2,105.3	9,000.0	64,500.0	(1)	9,191.5
California	1,051.3	5,228.2	593,603.8	26,574,000.0	3,039.6
Hawaii					
Oregon	962.3	3,448.7	331,363.6	(1)	3,978.3
Washington	1,190.3	4,516.0	821,444.4	(1)	5,951.4

[1] Less than 50,000 therms and/or less than 50 customers.

Source: American Gas Association.

balance the loads. Interruptible industrial customers buy gas with the understanding that service will be curtailed or cut off when high priority customers' requirements call for larger volumes of gas. Firm service is provided to the customers who buy gas under schedules or contracts which provide for no interruptions of service.

2. EXISTING CAPITAL PLANT

The principal investment of the gas distribution systems in this country consists of the gas main facilities. Distribution and integrated companies operated 458,640 miles of distribution pipelines, 105,470 miles of transmission pipelines and 39,300 miles of field and gathering pipeline, a total of 603,410 miles of mains in 1964. The location of these facilities by States is shown in table 4.

As noted above, there were 728 investor-owned systems and 773 municipal systems in 1965.[10] Over 93 percent of their customers were served by the 201 investor-owned and municipal gas systems with annual revenues of $1 million or more; these large systems are concentrated in the more populous areas as shown in table 5.

Details on the distribution of the 1,300 utilities with less than $1 million revenue are not available. However, further detail is available on the 773 municipal systems which reported to the AGA in 1964.[11] As shown in table 6 the concentration of municipals is decidedly in the smaller markets.

It can be seen in table 7 that about 97 percent of the industry's growth has taken place in the past 55 years and 65 percent of the growth has taken place in the past 15 years.

There is no inventory of pipe underground showing the vintage of the Nation's gas distribution mains, but the figures in table 8, which show the growth of the pipeline network since 1932, attest to the fact that about half of the pipe in use is less than 15 years old. Replacement of old pipe is sometimes necessary, usually to allow for carrying of larger volumes of gas but it is estimated that 95 percent of the pipe requirement of the gas utilities and pipelines is for new construction and 5 percent for replacement.[12]

Of the 736,200 miles of pipeline in 1964, 603,410 are used by distribution and integrated companies. Of the distribution and integrated company pipeline, 564,580 miles, or 93.6 percent, are operated by investor-owned utilities and the remaining 38,830 miles by municipal utilities. The distribution of the gas main by type of service and State is shown for investor-owned utilities in table 9 and for municipal utilities in table 10.

[10] Letter from Schwimmer, Apr. 14, 1966, and *Government in Gas* (New York: PAR Public Information Service, American Gas Association, 1965).

[11] *Ibid.*

[12] "Gas Industry Estimates Steel Needs" (New York: Bureau of Statistics, American Gas Association, Inc., Aug. 11, 1965).

TABLE 4.—*Miles of gas main of distribution and integrated companies by State and type of main,*[1] *1964*

	Total	Field and gathering	Transmission	Distribution
United States	603,410	39,300	105,470	458,640
New England	18,380		480	17,900
Connecticut	3,250		60	3,190
Maine				
Massachusetts	12,680		360	12,320
New Hampshire	580		10	570
Rhode Island	1,870		50	1,820
Vermont				
Middle Atlantic	87,370	6,500	13,660	67,210
New Jersey	16,450		1,500	14,950
New York	29,410	560	4,520	24,330
Pennsylvania	41,510	5,940	7,640	27,930
East North Central	124,020	4,770	15,020	104,230
Illinois	31,210	20	1,410	29,780
Indiana	13,980	260	2,420	11,300
Michigan	25,960	240	3,120	22,600
Ohio	41,450	4,250	6,760	30,440
Wisconsin	11,420		1,310	10,110
West North Central	69,480	4,460	22,210	42,810
Iowa	11,880	50	3,710	8,120
Kansas	22,610	4,350	8,950	9,310
Minnesota	9,600		2,200	7,400
Missouri	12,060		760	11,300
Nebraska	9,670	40	4,970	4,660
North Dakota	1,510	20	690	800
South Dakota	2,150		950	1,220
South Atlantic	63,020	8,460	9,660	44,900
Delaware	940		70	870
District of Columbia	1,150		20	1,130
Florida	6,340		270	6,070
Georgia	11,150		660	10,490
Maryland	6,120	40	320	5,760
North Carolina	6,360		1,440	4,920
South Carolina	4,690		1,180	3,510
Virginia	6,780	10	750	6,020
West Virginia	19,490	8,410	4,950	6,130
East South Central	35,130	2,570	5,070	27,490
Alabama	10,350		1,290	9,060
Kentucky	10,940	2,570	2,060	6,310
Mississippi	6,100		660	5,440
Tennessee	7,740		1,060	6,680
West South Central	99,420	8,320	24,98	66,120
Arkansas	10,200	440	3,040	6,720
Louisiana	15,030	650	2,700	11,680
Oklahoma	17,190	2,960	4,640	9,590
Texas	57,000	4,270	14,600	38,130
Mountain	37,610	3,550	7,860	26,200
Arizona	7,010	(2)	100	6,910
Colorado	7,950	360	730	6,860
Idaho	1,740		470	1,270
Montana	5,800	1,160	2,560	2,080
Nevada	1,520		780	740
New Mexico	6,180	1,360	1,160	3,660
Utah	4,010	180	370	3,460
Wyoming	3,400	490	1,690	1,220
Pacific	68,980	670	6,530	61,780
Alaska	150		10	140
California	58,240	670	6,350	51,220
Hawaii				
Oregon	4,930		90	4,840
Washington	5,660		80	5,580

[1] Excludes service pipe. Data not adjusted to company diameter equivalent. Mileage shown as of end of year.
[2] Less than 5 miles.

TABLE 5.—*Number of gas distributors, customers and population served, all gas utilities with over $1,000,000 revenue, 1965*

Population (class interval)	Number of utilities	Number of customers (in thousands)	Population in area served (in thousands)
500,000 or more	69	29,101	121,869
100,000 to 499,999	84	4,326	19,556
50,000 to 99,999	24	435	1,760
10,000 to 49,999	21	182	649
2,500 to 9,999	3	8	21
Under 2,500			
Total	201	34,052	143,855

Source: Schwimmer, *op. cit.*

TABLE 6.—*Number of municipal gas distributors and population served, 1964*

Population (class interval)	Number of utilities	Population in area served (in thousands)
5,000,000 or more	[1] 2	[1] 2,590
100,000 to 499,999	8	2,226
50,000 to 99,999	8	528
10,000 to 49,999	89	2,670
2,500 to 9,999	260	1,625
Under 2,500	405	506
Total	[1] 772	[1] 10,145

[1] Excludes Houston, Tex. One part of Houston is served by a city-owned gas system, but about 95 to 98 percent of the city's population reside in areas served by private gas companies.

Source: *Government in Gas* (New York: PAR Public Information Service, American Gas Association, 1965) and U.S. Bureau of the Census, *U.S. Census of Population, Number of Inhabitants* (Washington: U.S. Government Printing Office, 1961).

TABLE 7.—*Sales of gas to consumers by utilities and pipeline companies* [1]

Year:	*Billion therms*	Year—Continued	*Billion therms*
1910	3.7	1945	25.9
1920	6.2	1950	42.1
1930	13.6	1955	66.6
1935	12.9	1960	92.9
1940	17.2	1965	120.8

[1] Excludes sales for resale.

Source: American Gas Association Monthly (issue of January 1966) cover and p. 1, and *Gas Facts, op cit.*

TABLE 8.—*Miles of pipeline in use at end of year, distribution, integrated and natural gas pipeline companies*

[In thousand miles]

Year	Total	Field and gathering	Transmission	Distribution
1945	310.7	27.0	82.2	201.5
1946	319.0	26.5	87.3	205.2
1947	331.4	27.0	92.9	211.5
1948	346.4	29.2	97.0	220.1
1949	364.1	30.9	102.9	230.3
1950	387.5	32.9	113.0	241.6
1951	406.6	34.6	119.1	252.9
1952	424.2	38.3	122.0	263.9
1953	445.2	41.3	129.0	274.9
1954	470.5	43.8	139.0	287.7
1955	496.7	45.7	145.9	305.1
1956	525.2	47.6	153.8	323.8
1957	548.8	50.0	160.1	338.7
1958	571.5	52.0	165.4	354.1
1959	599.9	54.1	174.4	371.4
1960	630.9	55.8	183.7	391.4
1961	659.0	56.7	191.9	410.4
1962	683.2	58.7	196.4	428.1
1963	709.9	60.7	200.9	448.3
1964	736.2	61.0	205.4	469.8

Source: Gas Facts, *op. cit.*

TABLE 9.—*Miles of main of investor-owned distribution and integrated companies natural gas, by State and by type of main—1964* [1]

	Total	Field and gathering	Transmission	Distribution
United States	564,580	39,190	100,940	424,450
New England	17,970		480	17,49
Connecticut	3,160		60	3,100
Maine				
Massachusetts	12,360		360	12,000
New Hampshire	580		10	570
Rhode Island	1,870		50	1,820
Vermont				
Middle Atlantic	84,490	6,500	13,660	64,330
New Jersey	16,450		1,500	14,950
New York	29,380	560	4,520	24,300
Pennsylvania	38,660	5,940	7,640	25,080
East North Central	122,400	4,690	14,600	103,110
Illinois	30,470	20	1,270	29,180
Indiana	13,570	260	2,210	11,100
Michigan	25,960	240	3,120	22,600
Ohio	40,980	4,170	6,690	30,120
Wisconsin	11,420		1,310	10,110
West North Central	65,470	4,360	22,030	38,980
Iowa	11,430	50	3,700	7,680
Kansas	22,130	4,350	8,920	8,860
Minnesota	8,970		2,190	6,780
Missouri	11,310		680	10,630
Nebraska	8,030	40	4,920	3,070
North Dakota	1,510	20	690	800
South Dakota	2,090		930	1,160
South Atlantic	54,650	8,460	8,590	37,600
Delaware	940		70	870
District of Columbia	1,150		20	1,130
Florida	3,760		60	3,700
Georgia	8,030		50	7,980
Maryland	6,120	40	320	5,760
North Carolina	5,770		1,410	4,360
South Carolina	3,600		990	2,610
Virginia	5,790	10	720	5,060
West Virginia	19,490	8,410	4,950	6,130
East South Central	22,490	2,560	2,870	17,050
Alabama	4,980		90	4,890
Kentucky	10,130	2,560	1,900	5,670
Mississippi	5,140		510	4,630
Tennessee	2,240		380	1,860
West South Central	92,820	8,300	24,470	60,050
Arkansas	9,830	440	2,980	6,410
Louisiana	13,230	650	2,520	10,060
Oklahoma	16,900	2,960	4,610	9,330
Texas	52,860	4,250	14,360	34,250
Mountain	36,420	3,550	7,720	25,150
Arizona	6,690	[2]	40	6,650
Colorado	7,410	360	710	6,340
Idaho	1,740		470	1,270
Montana	5,800	1,160	2,560	2,080
Nevada	1,520		780	740
New Mexico	5,850	1,360	1,100	3,390
Utah	4,010	180	370	3,460
Wyoming	3,400	490	1,690	1,220
Pacific	67,870	670	6,510	60,690
Alaska	150		10	140
California	57,230	670	6,350	50,210
Hawaii				
Oregon	4,930		90	4,840
Washington	5,560		60	5,500

[1] Excludes service pipe.
[2] Less than 5 miles.

Source: Schwimmer, *op. cit.*

TABLE 10.—*Miles of main of municipal companies, natural gas, by State and by type of main, 1964* [1]

	Total	Field and gathering	Transmission	Distribution
United States	38,830	110	4,530	34,190
New England	410		(2)	410
Connecticut	90		(2)	90
Maine				
Massachusetts	320		(2)	320
New Hampshire				
Rhode Island				
Vermont				
Middle Atlantic	2,880		(2)	2,880
New Jersey				
New York	30			30
Pennsylvania	2,850		(2)	2,850
East North Central	1,620	80	420	1,120
Illinois	740		140	600
Indiana	410		210	200
Michigan				
Ohio	470	80	70	320
Wisconsin				
West North Central	4,010		180	3,830
Iowa	450		10	440
Kansas	480		30	450
Minnesota	630		10	620
Missouri	750		80	670
Nebraska	1,640		50	1,590
North Dakota				
South Dakota	60			60
South Atlantic	8,370		1,070	7,300
Delaware				
District of Columbia				
Florida	2,580		210	2,370
Georgia	3,120		610	2,510
Maryland				
North Carolina	590		30	560
South Carolina	1,090		190	900
Virginia	990		30	960
East South Central	12,640	10	2,190	10,440
Alabama	5,370		1,200	4,170
Kentucky	810	10	160	640
Mississippi	960		150	810
Tennessee	5,500		680	4,820
West South Central	6,600	20	510	6,070
Arkansas	370		60	310
Louisiana	1,800		180	1,620
Oklahoma	290		30	260
Texas	4,140	20	240	3,880
Mountain	1,190		140	1,050
Arizona	320		60	260
Colorado	540		20	520
Idaho				
Montana				
Nevada				
New Mexico	330		60	270
Utah				
Wyoming	(2)			(2)
Pacific	1,110		20	1,090
Alaska				
California	1,010			1,010
Hawaii				
Oregon				
Washington	100		20	80

[1] Excludes service pipe.
[2] Less than 5 miles.

The value of the gas utility and pipeline plant of natural gas distribution and integrated companies at the end of 1964 is shown in table 11.

TABLE 11.—*Gas utility plant of natural gas distribution and integrated companies as of Dec. 31, 1964 (gross plant excluding manufactured gas plant)*

[In millions]

	Investor owned	Municipal	Total
Total utility plant and adjustments	$14,940	$860	$15,800
Production and local storage	1,430	115	1,545
Underground storage	695	5	700
Transmission	3,045	(1)	3,045
Distribution	8,835	645	9,480
General and intangible [2]	725	65	790
Construction work in progress	210	30	240

[1] Less than $5,000,000.
[2] Includes plant acquisition adjustments and plant adjustments.

Source: Schwimmer, *op. cit.*

B. Costs and User Charges

1. CONSTRUCTION AND OPERATING COSTS

The American Gas Association reports that 21,530 miles of distribution pipe were installed in 1964. Construction expenditures amounted to $784 million during the year or an average cost of $36,414 per mile. According to the AGA, "this average construction cost per mile of distribution main includes the expenses involved in bringing gas service to new customers and the strengthening of service to existing customers." [13]

The total mileage of natural gas pipeline of investor-owned distribution and integrated companies at the end of 1964 was 564,580 miles, as shown in table 9. During 1964, $1,421 million were expended for the operation and maintenance of these lines (including $1,205 million for operating expense and $216 million for maintenance).[14] This expenditure represents an average of $2,517 per mile, of which $2,134 is operating expense and $383 is maintenance expense. No data are available to measure the average per mile cost for operation and maintenance of municipally owned utilities.

2. USER CHARGES

Investor-owned utilities set rates at levels designed to recover total operating and maintenance expenses, depreciation costs, taxes, and return on investment. Municipal utilities set their rates to recover all costs including debt service and payments to municipal governments in lieu of taxes. There may be isolated instances of municipal utilities operating at a deficit but these would be exceptions to the general practice of gas distributors. Outlays for facilities and structures of municipal utilities are normally met from retained earnings or from special bonds rather than out of the general tax resources and general obligation borrowings of the municipalities.

[13] Schwimmer, *op. cit.*
[14] *Gas Facts, op. cit.* pp. 195–198. This excludes $3,356,000,000 purchased gas costs.

The rates of investor-owned distribution utilities are generally regulated by State commissions and the rates of municipal distribution systems are generally fixed by the municipal authorities. Prices for gas paid by all distribution systems to interstate pipeline companies are regulated by the Federal Power Commission.

C. Trend of Capital Outlays

The growth of the gas distribution pipeline network (see table 8) has been paralleled by increasing construction expenditures for distribution facilities (see table 12). Chart 1 shows the comparison of growth trends for the latter expenditures, natural gas production, number of gas customers, and average use per customer.

TABLE 12.—*Construction expenditures for gas distribution facilities, 1946–64*

[Dollar amounts in millions]

Year	Expenditures	Year	Expenditures
1946	$105	1956	$534
1947	178	1957	593
1948	219	1958	541
1949	240	1959	643
1950	299	1960	696
1951	331	1961	687
1952	349	1962	708
1953	383	1963	752
1954	423	1964	784
1955	500		

Source: *Gas Facts.*

As shown in table 13, the concentration of utility plant for all gas distribution and integrated companies (including natural, manufactured, mixed, and LP gas companies) in the investor-owned segment of the industry has declined only slightly during the past 10 years.

TABLE 13.—*Gas utility plant—All distribution and integrated companies, 1954–64*

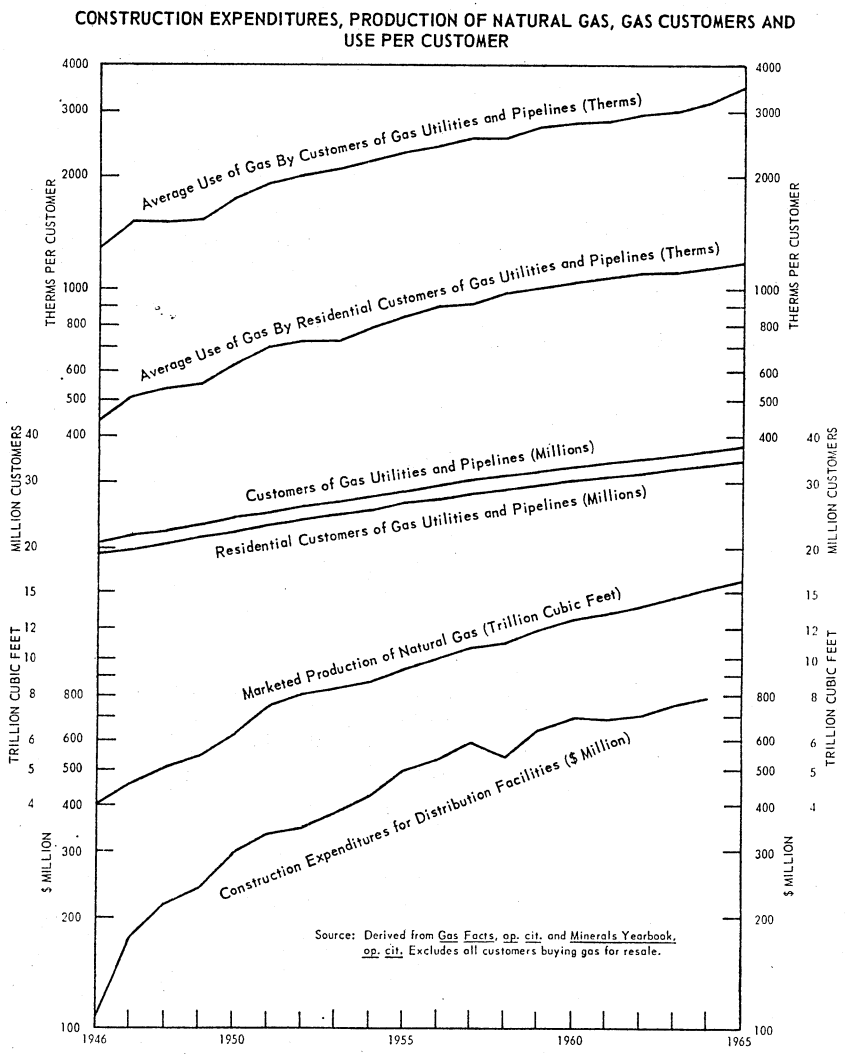
[Dollar amounts in millions]

Year	Investor-owned utilities	Municipal utilities	Total	Municipals as percent of total
1954	$7,670	$400	$8,070	5.0
1955	8,115	445	8,560	5.2
1956	8,780	440	9,220	5.8
1957	9,490	530	10,020	5.3
1958	10,200	605	10,805	5.7
1959	11,195	540	11,735	4.6
1960	11,875	690	12,565	5.4
1961	12,980	740	13,720	5.4
1962	13,690	795	14,485	5.4
1963	14,615	890	15,505	5.7
1964	15,305	940	16,245	5.8

Source: Derived from *Gas Facts.* Includes manufactured gas plant.

Based on the trends in plant expansion, it appears that municipals probably account for about 5½ percent of the construction expenditures for gas distribution facilities in recent years.

CHART 1



Sources of financing for the construction and expansion of gas distribution systems are not available in detail. Since 1946 investor-owned gas utility and pipeline companies have received 64 percent of their new capital from debt issues, 28 percent from common stock issues and 8 percent from preferred stock issues.[15] In addition, internally generated funds have become increasingly important; internal sources provided financing for about one-third of the gas utility and pipeline construction in the late 1950's and are now providing about half of the construction funds.

[15] Based on data in *Gas Facts* plus information from AGA.

The sources of financing for all construction by municipal utilities are not reported. Certain of the smaller municipal utilities are eligible for loans from the Community Facilities Administration. Such loans to municipal utilities have been used to supply less than one-half percent of total construction expenditures by all gas distribution systems.[16]

D. Needs and Prospective Capital Outlays

The projected expansion of the Nation's gas pipeline network, including field and gathering, transmission and distribution mains, as estimated by the American Gas Association is shown in table 14.

Table 14.—*Projected miles of main, gas utility and pipeline industry, 1964–75*

[In thousands]

Year	Field and gathering [1]	Transmission	Distribution	Total
1964 (actual)	61.0	205.4	469.8	736.2
1965	63.1	210.9	491.4	765.4
1966	64.5	216.3	514.3	795.1
1967	65.9	221.6	537.6	825.1
1968	67.4	226.8	559.1	853.3
1969	68.7	231.9	581.6	882.2
1970	70.0	236.8	604.3	911.1
1974	75.1	255.5	699.1	1,029.7
1975	76.3	260.0	724.1	1,060.4

[1] Excludes field and gathering facilities of producers. Reflects only field and gathering mains of pipelines and distribution companies.

Source: Projected Gas Utility and Pipeline Industry Statistics: 1965-75, *op. cit.*

Construction expenditures of the gas distribution and integrated utility and pipeline companies for this period are projected as shown in table 15.

Table 15.—*Projected gas utility and pipeline industry construction expenditure by function, 1964–75*

[In millions of dollars]

Year	Construction expenditures					
	Total	Production and local storage	Transmission	Underground storage	Distribution	General
1964	1,701	120	616	84	784	97
1965 [1]	1,913	191	688	121	809	104
1966 [1]	1,979	160	842	97	795	85
1967 [1]	1,847	152	680	118	798	99
1968 [1]	1,801	145	647	103	821	85
1969	2,037	171	683	97	971	115
1970	2,071	169	688	105	992	117
1974	2,265	165	700	120	1,152	128
1975	2,315	164	701	123	1,196	131

[1] Represents forecasts based on estimates submitted by individual gas companies.

Source: *Projected Gas Utility and Pipeline Industry Statistics*, 1965-75, *op. cit.*

[16] Letter from Melvin S. Frazer, Acting Commissioner, Community Facilities Administration, Department of Housing and Urban Development, Mar. 7, 1966, indicates that from 1957 through 1964 CFA loans of $16 million were made for gas projects. During this period construction expenditures (see table 12) totaled over $5,400 million.

These projections of miles of mains and construction expenditures reflect five basic assumptions: [17]

1. A continuation during 1964–75 of the long term economic growth of the country.
2. Natural gas supply will be available from producers for pipelines, and from pipeline for distributors as required to meet customer demands.
3. Competitive fuel prices will maintain their same relative position to gas prices.
4. Future major technological changes in the fuel industries have not been incorporated.
5. A continuation of the general inflationary cost trend.

In preparing these projections the following factors were given consideration: [18]

1. Accommodating the growing population.
2. Supplying customers with any increased demands per customer that will develop.
3. Supplying additional customers in areas where the number of customers will increase more rapidly than population.

No projections have been made indicating growth by size of community or size of service area.

The outlook for construction expenditures as shown in table 15 is heavily weighted by the projected operations of the investor segment of the industry. The stability of the relative position of investor-owned and municipal systems in the Nation's gas industry is illustrated in table 16.

TABLE 16.—*Municipal gas distributors as percent of industry totals*

Year	Customers [1]	Sales [1]	Revenues [1]	Gas utility plant		New communities initially served with gas [2]
				All plant [2]	Distribution plant only [2]	
1958	4.4	6.8	5.4	5.7	7.5	29
1959	4.6	6.9	5.3	4.6	6.7	26
1960	4.7	6.9	5.4	5.4	7.2	9
1961	4.8	7.0	5.4	5.4	7.1	16
1962	4.8	7.1	5.4	5.4	7.7	9
1963	4.8	7.2	5.4	5.7	7.0	11
1964	4.7	7.3	5.4	5.8	7.1	(3)

[1] As percent of total gas distribution, integrated and pipeline companies.
[2] As percent of total gas distribution and integrated companies.
[3] Not available.

Source: Based upon information received from AGA and *Gas Facts*.

The investor-owned utilities are expected to finance their expansion program for the next 4 years approximately as follows: 50 percent from internal sources, 45 percent from debt issues, and 5 percent from new equity issues.[19] Assuming a continuance of the trend toward increasing use of internally generated funds and decreasing use of new equity issues, while the relative use of debt issues has remained fairly constant, there will be a slight increase in the use of internally generated funds in the latter part of the decade.

[17] Schwimmer letter, Mar. 29, 1966.
[18] *Ibid.*
[19] *Ibid.*

With respect to the outlook for financing of municipal gas utilities, a study by the Council of State Governments indicates that about half of their projected construction expenditures will be financed with bond issues. The balance will presumably come from internally generated funds. Some municipal systems serving small communities will be eligible for loans from the Department of Housing and Urban Development as they have been in the past. However, such loans will provide only a small proportion of the municipals' needs.

All available studies on the gas industry point to continued financial strength. Both the investor-owned companies and the municipals should be able to finance their expansion as they have done in the past.

CHAPTER 10

Highways, Roads, and Streets*

A. NATURE AND COMPOSITION OF HIGHWAY PLANT IN THE UNITED STATES

1. DESCRIPTION OF FACILITIES

At the end of 1964, there were 3.6 million miles of roads and streets in the United States. These ranged in type of service from the highest class of modern multilane, controlled access freeways, serving intercity and interstate traffic movements, through the collector roads that move people and goods from the producer to the consumer, down to the local roads and streets that provide access to the farms, the industries, and the residences of nearly everyone in America.

We truly live in the age of the automobile, and as a Nation on wheels we must place great dependence upon the highway network to move our commerce, to afford us access to working, living, and recreational areas, and to provide for the great variety of services in the protection of life, health, and safety that our populace demands and expects.

The term "highway" includes roads, streets, and parkways, and also includes rights-of-way, bridges, railroad-highway crossings, tunnels, drainage structures, signs, guardrails, and protective structures, in connection with highways. "Highway," "street," or "road" are general terms denoting a public way for purposes of vehicular and pedestrian travel, including the entire area within the right-of-way. In rural areas, or in urban areas where there is comparatively little access and egress, a way between prominent termini is called a highway or a road. A way in an urban area, with or without provision for curbs, sidewalks, and paved gutters is ordinarily called a street.

The right-of-way consists of the entire strip of land set aside or devoted to highway use. It encompasses all the essential elements of a highway cross section, such as traffic lanes, auxiliary lanes, shoulders, highway signs, traffic control devices, roadside developments, and median strips. The roadbed itself is the graded portion of the right-of-way upon which the base course, surface, shoulders, and median are constructed.

The thickness of the surface and base and the type of pavement are determined by volume and composition of traffic, availability of materials, and the experience of contractors. Pavements may be considered as three general types: (1) High; (2) intermediate; and (3) low. High-type pavements are for high-volume traffic, provide smooth riding qualities, and good antiskid properties in all weather. The surface should retain its qualities and should provide adequate support for the expected volume and weights of vehicles without undue fatigue, thus keeping maintenance costs to a minimum. Inter-

*Prepared by the Bureau of Public Roads, U.S. Department of Commerce, with minor editing by committee staff.

mediate-type surfaces vary all the way from relatively low-cost surface treatments to pavements that are only slightly less costly and lower in strength than the most expensive high-type pavements. Low-type surfaces range from surface treated earth roads and stabilized materials to loose surfaces such as earth, shell, and gravel.

Highways range from single-lane rural roads to high-speed multilane facilities of eight or more lanes. Single-lane roads are considered suitable only in low-traffic-density areas where the average daily traffic is fewer than 100 vehicles. A single-lane road may vary from 8 to 14 feet wide and serve traffic in both directions. By far the greatest mileage of highways consist of two lanes, but the mileages of four, six, eight, and more lane facilities are increasing rapidly. Lane widths are usually determined by a combination of factors such as speed, traffic composition, traffic volume, and, of course, cost. There is still a large mileage of highways with lanes less than 12 feet wide, but for a modern high-speed facility, 12 feet is generally considered to be a minimum acceptable lane width.

A highway shoulder is the portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses. It varies in width from practically nothing on low-traffic rural roads, to 12 feet or even more on major roads, where the entire shoulder may be stabilized or paved.

Traffic control signs, lights, and markings, are provided for the convenience and protection of motorists, but lighting of rural highways is seldom found or considered to be justified except on critical curves, intersections, long bridges, tunnels, and areas where roadside interference is a factor.

Intersections are points of conflict and potential hazards: Ingress and egress on most highways are accomplished by direct at-grade connections. Local conditions and cost of right-of-way influence the type of intersection selected as well as many of the design details. It is mostly on divided, controlled access highways that special structures are provided to eliminate intersections at grade, with ramps and speed-change lanes provided for safe entry and exit.

The gradients on secondary and minor rural roads generally follow the natural contours of the land. In mountainous terrain the grades are frequently quite steep and the sight distance critically reduced. On major high-speed highways, gradients are limited so that reasonable speeds can be maintained by both automobiles and trucks. For design speeds of 50, 60, and 70 miles per hour on the Interstate System, gradients generally are not steeper than 3, 4, or 5 percent, except in rugged terrain where 2 percent steeper grades may be permitted.

The road and street systems in the United States have grown but little in extent in recent years, the total mileage increase since 1956 being less than 1 percent per year. The Nation's needs lie generally not in a large increase in mileage, but in improvement or replacement of existing highways. As one indication of improvement progress, the mileage of unsurfaced roads and streets has been declining at an average rate of 2 percent during recent years. The effects of the expansion of urban areas and population are reflected in the fact that municipal mileage has increased an average of nearly 4 percent per year since 1956.

2. EXISTING CAPITAL PLANT

(a) *Distribution and Growth*

A comparison of total, municipal, and unsurfaced mileages for the years 1956–64 follows:

[In thousands of miles]

Year	Total mileage	Municipal mileage	Unsurfaced mileage
1956	3,430	379	1,107
1957	3,454	389	1,082
1958	3,479	405	1,031
1959	3,503	416	1,008
1960	3,538	430	989
1961	3,573	446	985
1962	3,600	455	953
1963	3,620	475	927
1964	3,644	491	914

The distribution by States of the total mileage at the end of 1964 is given in appendix table A.

Of the 491,000 miles of city streets, 62,000 are under State control and are, for the most part, the more important cross-city connections of the main trunkline systems, including most of the major urban expressways and arterials. The remaining 429,000 miles are generally the local community and residential streets for which the cities have responsibility for maintenance and improvement.

No recent inventory of local streets has been made, but upon the basis of a study of 1961 local mileages by city population groups, it is possible to estimate that the 429,000 miles of local government streets would be arrayed as follows:

Population group	Mileage	Number of cities	Average mileage per city
Under 5,000	130,743	15,172	8.62
5,000 to 9,999	47,102	1,420	33.17
10,000 to 24,999	64,791	1,141	56.78
25,000 to 49,999	43,237	422	102,46
50,000 to 99,999	40,403	209	193.32
100,000 and over	103,091	140	736.36
Total	429,367	18,504	----------

No precise correlation exists between the mileage of streets and the population of the community, but a composite ratio of 240 persons to 1 mile of street was developed in 1961 for cities under 100,000 population, taken as a group.

Much study has been made of the service life of various types of roads, and the various elements comprising the road, such as land, grading, surfacing, and structures. Some of the factors developed from such studies will be discussed later. First, two other factors must be understood: (1) Roads not only wear out, they become functionally obsolete as a result of community growth, unanticipated changes in community patterns that change the volume of traffic, technological improvements in vehicles, and general reorientation of the economy that results in increased traffic movements and/or

speeds that exceed the capacities of the roads, even though structurally they may be sound; (2) the measurement of needs, which will be reported in a later section, is perhaps the best indicator of the extent to which the highway plant is—or will become—inadequate for the next decade.

During the years 1956–64, inclusive, the States built, reconstructed, or resurfaced a total of 317,000 miles of rural State highways, an average of over 35,000 miles per year. This same network of roads totaled 620,000 miles in 1955; 681,000 miles in 1964. Thus, in terms of turnover, the entire system can be expected to have some degree of improvement over a period of about 20 years. No similar data are available for local roads and streets.

From a physical standpoint, some studies have assigned the following depreciation rates for highways:

	Annual rate (percent)
Right-of-way	0
Grading	1
Surface and base	3
Structures	2

From values determined in Bureau of Public Road studies, an annual weighted rate of 1.39 percent could be used for cost amortization purposes. Obviously, this rate would not necessarily be a typical one, nor would it reflect obsolescence.

The record of rural mileage built by the State highway departments since 1923 is as follows:

	Miles
1923–40	550,000
1941–60	632,000
1961–64	136,000

Because many roads have been reconstructed or resurfaced more than once during this time, this tabulation can afford only a measure of the volume of construction activity, but not an approximation of the age distribution of the rural State highway system.

(*b*) *Ownership Patterns*

As will be seen from appendix table A, the States are responsible for some 743,000 miles of roads and streets, or about 20 percent of the total; local governments administer nearly 2.8 million miles of highways or 76 percent; while about 4 percent of the mileage is under Federal control, chiefly in the public domain areas. Trafficwise, however, the main rural roads, which are generally State-administered routes, carry about 75 percent of all vehicular travel on rural roads. Thus, based on traffic volumes, the States have a far larger share of responsibility for highways than the mileage statistics would indicate.

It is estimated that the current value of the Nation's highways (excluding toll facilities) was $63 billion at the end of 1964.

B. Costs and User Charges

1. CONSTRUCTION AND OPERATING COSTS

Typical construction costs: Many factors determine the cost of building a mile of highway, not the least of which is the cost of land acquisition, which in some urban areas can exceed the physical costs

of construction. Other factors are governed by the geometrics of design, such as vertical and horizontal curvature, width of roadway, number and frequency of interchanges, etc., and by the type of terrain, which may be mountainous, rolling, or flat. For rural roads in rolling terrain some average construction costs are as follows (excluding land acquisition and on-site engineering costs):

Roadway width	Type	Average cost per mile
24 feet	Federal-aid secondary	$70–$80, 000
Do	Federal-aid primary, noninterstate (medium type)	100–125, 000
Do	Federal-aid primary, noninterstate (high type)	160–200, 000
48 feet divided	Federal-aid interstate	600–700, 000

The cost of urban highways is generally much greater than that of the rural sections. On the Federal-aid Interstate System, the costs to build urban sections (again excluding land acquisition and on-site engineering costs) can be expected to average $1.5 million per mile for four-lane construction; $3.3 million for six-lane; and $5.3 million for eight-lane construction, based on current price levels.

Typical annual maintenance and operating costs. Here again there are many variables, such as traffic volume and frequency of heavy axle loads, terrain, number of lanes and interchanges, winter maintenance (snow and ice control), other traffic services, toll road operations, etc. In 1964, $1,055 million was expended for maintenance of the 681,000 miles of rural State-administered highways, or slightly more than $1,500 per mile, on the average. During the same year, $171 million was identified as maintenance on the 62,000 miles of municipal State highways, or over $2,700 per mile, average.

From preliminary studies, the cost of maintenance and traffic services on completed sections of the Interstate System show the following weighted average annual costs:

	Costs per mile
Rural sections (excluding interchanges)	$2, 593
Urban sections (excluding interchanges)	5, 120
Rural sections (including interchanges)	3, 153
Urban sections (including interchanges)	9, 698

2. USER CHARGES

Although highways have many aspects of a public utility in that they provide a service to the users, and the pricing of this service is in many respects based upon frequency and extent of use, here the analogy ceases. Many students of highway taxation argue that there are three classes of beneficiaries of highways, and that costs of highway transportation should be borne among the three according to the benefits derived. These three are: (1) The *user*, who would be expected to pay most of the costs of freeways and other major traffic arteries; but lesser amounts of the costs of collector roads and local land-access roads and streets; (2) the *community* which benefits collectively from highways that make possible such community services as fire and police protection, ambulance, and other lifesaving services, and sanitation facilities among others; and that should pay for a large share of the cost of collector and local roads from general

taxation; (3) the *land*, which without access to transportation would have little value and hence should pay most of the costs of residential streets and other local land-service roads through property taxes or assessments.

Some would maintain that all benefits to land and the community are in reality user benefits that have merely been transferred. These arguments are brought out here by way of explaining that user charges for highways are not necessarily intended to be sufficient to cover all highway costs. In 1964, $12.6 billion of income was applied for highway purposes (exclusive of borrowings). Of this amount, $10.0 billion was provided from user taxes, fees, and tolls (including $3.6 billion of Federal highway trust fund revenues), and $2.6 billion from nonuser taxes, appropriations, and miscellany. Interestingly enough, in that year an additional $2.6 billion was collected from users, but not applied for highways (the Federal excise tax on automobiles and parts and accessories, and State user taxes applied for nonhighway purposes). Thus on balance there was a trade-off whereby user taxation actually would have been sufficient to provide all funds applied to highways.

Appendix table B lists for each of the years 1946–65, inclusive, the amounts of user revenues allocated for highway purposes, together with amounts provided from nonuser sources. Maintenance, operation, and annual debt service payments are then recorded as charges against these revenues, with the excess shown as an amount available for capital outlay. Also shown as available for capital outlay are the amounts of Federal-aid funds paid in reimbursement to the States for work performed, together with small amounts of direct Federal outlays; and proceeds of construction bond issues. Since 1956, the Federal-aid highway funds have their source in excises on motor fuel and on certain automotive products that are placed in the Federal highway trust fund, and that are considered to be user revenues. Although there was no trust fund prior to 1956, the annual revenue from the Federal tax on gasoline was more than sufficient to cover the annual Federal-aid highway appropriations, but there was no explicit linkage.

The data in table B are also arranged so as to show the sources of funds collected by each of the four levels of government: Federal, State, county, and city; and the direct outlays by each for the purposes indicated.

C. Trend of Capital Outlays

Table B records the capital outlays for highways during the period 1946–65. The term "capital outlays" is understood to include contract and force account construction; preliminary and construction engineering on site; and right-of-way costs, including land acquisition, utility and tenant relocation costs, condemnation costs, etc. It does not include the costs of sidewalks or street lighting, unless part of a road construction contract.

The table shows the expenditure according to three functional classes of highways: main rural roads, which include the major interurban highways and toll roads; local rural roads, which include collector and feeder roads, both under State and local jurisdiction; and urban streets and highways, which include both connections of State highways and local city streets.

As a secondary classification, table B shows capital outlay according to the governmental level administering the expenditure: Federal, State, or local units. Because the States administer the Federal-aid highway programs, Federal-aid expenditures are a component of those shown for State agencies. The small amount of direct expenditures by the Federal Government are those administered by the U.S. Forest and Park Services, and other ancillary programs.

In accordance with the requirements of national growth and increasing dependence on highway transportation, the trend of highway expenditures has been upward, save for brief periods of slight declines, not in themselves significant. As the highway programs are geared to the economy and the demands for transportation as evidenced by such factors as population growth, car ownership trends, travel, and disposable income, among others, the outlays for highways have moved in large measure with the gross national product.

Some of the sources of financing highway capital outlays are known explicitly, such as Federal-aid funds and borrowings. The remainder of the funds are supplied from current Federal, State, and local income, chiefly from user taxes which provide not only appropriations, but State grants-in-aid as well. It is not possible to isolate these elements. For example, State grants-in-aid are frequently available for both road construction and maintenance, and may even be commingled with, and augmented by local government revenues and lose their identity as a discrete source of funds either for capital outlays or for operations.

The funds available for capital outlay (pt. C of table B) have exceeded the expenditures (pt. D), in most years, chiefly because bond proceeds are not usually expended entirely within the year in which sold, but may be carried in part as a reserve. At the end of 1964, the States had reserves (excluding debt and sinking funds) totaling $2.2 billion.

The States have been the chief roadbuilding agencies throughout the period covered, and have accounted for an increasing proportion of total outlays between 1946–65; from 66 to 80 percent.

Some 875,000 miles out of a total of 3,650,000 miles of roads and streets in the United States are eligible for improvement with Federal aid highway funds, or about 24 percent. Table C classifies the State and local road systems according to their eligibility for Federal assistance as part of the Interstate System, other Federal aid primary system routes, and the Federal aid secondary system. The "urban" classification of Federal aid highways refers to mileages within municipalities and other urban places having a population of 5,000 or more; all other Federal aid highways being classed as "rural." This explains the fact that some "rural" mileage (in places under 5,000 population) is found on local municipal street systems.

Table D, using the same format as table C, records the 1964 capital expenditures by the States on Federal and non-Federal systems; while table E records the 1964 estimated capital expenditures by all units of government. From table E it will be seen that $6.4 billion out of a total of $8.2 billion, or 78 percent, of all capital expenditures were for roads comprising Federal aid systems; and that a similar percentage of total outlays were made on State-administered highways.

All of this is by way of emphasizing that road improvements are concentrated on roads under the States' administrative control, and on systems eligible for Federal fund participation.

D. Needs and Prospective Capital Outlays

Pursuant to Public Law 89–139, the Bureau of Public Roads is directed to report to Congress in January 1968 estimates of the future highway needs of the Nation. It is impossible at this time to report on what these needs will be, and so for purposes of the study, prior estimates of needs have been used, principally those contained in the highway cost allocation study prepared and submitted to Congress as authorized by section 210 of the Highway Revenue Act of 1956 (70 Stat. 387), and the 1965 Interstate System cost estimate, published in 1965 as House Document No. 42, 89th Congress, 1st session. To the extent possible, these prior studies have been adjusted and modified to make them applicable to the 10-year period, 1966–75.

Table G tabulates the forecast of capital requirements in terms of amounts that probably would be assigned to State agencies, and to local governments; and in terms of the three functional classes of highways. Of the total of nearly $126 billion of estimated needs, 84 percent will be required for main rural roads and for urban streets in nearly equal proportions, with the remaining 16 percent required for local rural roads.

Table F projects estimated receipts for highways, "fixed" costs, and funds available for capital outlay during each of the years 1966–75. Projections of user revenues are based on economic projections of population, car ownership, travel, and slight annual increases in weighted motor-fuel tax rates. The present resources of the Federal highway trust fund are assumed to be extended without change through 1975.

The amount of capital expenditures in table F are then summed, and entered in total in table G. In virtually all comparisons of needs with anticipated resources, the former exceeds the latter. This is the finding as shown on table G, whereby a deficit of nearly $25 billion is forecast and is explained by the fact that needs are postulated without regard to restraints upon financing resources, but rather are a measurement of deficiencies in terms of engineering and geometric standards in light of probable levels of service demands. In other words, needs are calculated on the basis of eliminating most of the impediments to free flow of anticipated traffic volumes by some future target date.

Experience has shown that this objective has rarely been realized. With the notable exception of the Interstate System, which has a 1972 target date for completion, the remaining Federal, State, and local highway programs do not envision a "completion" date. Rather, the programs look to long-range efforts to renovate, upgrade, and otherwise bring highway systems to higher standards, recognizing that adequacy is an elusive term in the context of dynamic and changing demands for transportation.

This is by way of explaining that there is no real answer to the question of how to bridge the gap between resources and needs. The public must measure the demand for schools, for housing, and for other needs of society against that of highway transport and allocate its support accordingly. Certainly, priority programs can and will be developed both at the Federal and State levels that will produce the financial resources to meet delimited needs. Most of the nonpriority needs, particularly those in rural areas, will probably not be met within the next decade, or for some other time thereafter.

TABLE A.—*Total road and street mileage in the United States, 1964—Classified by system*

State	Rural mileage									
	Under State control				Under local control				Under Federal control [4]	Total rural roads
	State primary system	State secondary roads [1]	Other State roads [2]	Total	County roads	Town and township roads	Other local roads [3]	Total		
Alabama	8,174	9,103	864	18,141	47,892			47,892		66,033
Alaska	3,242		913	4,155			1,640	1,640	124	5,919
Arizona	4,968			4,968	16,265			16,265	12,067	33,300
Arkansas	11,353			11,353	55,403		4,713	60,116	1,951	73,420
California	12,282		2,316	14,598	69,826		8,918	78,744	25,208	118,550
Colorado	8,010		17	8,027	65,474			65,474	159	73,660
Connecticut	328	977	198	1,503		3,670		3,670		5,173
Delaware	439	3,010		3,449						3,449
Florida	9,450	5,414	266	15,130	44,526			44,526		59,656
Georgia	14,851		55	14,906	67,754			67,754	28	82,688
Hawaii	457	589	2	1,048	1,319			1,319	67	2,434
Idaho	4,608		48	4,656	17,017	9,788		26,805	7,787	39,248
Illinois	13,009			13,009	16,304	73,210		89,514		102,523
Indiana	9,739		157	9,896	77,403			77,403		87,299
Iowa	8,827		202	9,029	90,622			90,622		99,651
Kansas	9,753		237	9,990	113,638			113,638	9	123,637
Kentucky	20,645		118	20,763	44,069			44,069	264	65,096
Louisiana	3,753	10,325	30	14,108	26,324			26,324		40,432
Maine	3,296	7,309	241	10,846		7,669		7,669	142	18,657
Maryland	1,793	2,843	71	4,707	14,599			14,599		19,306
Massachusetts	779		296	1,075		6,288		6,288		7,363
Michigan	8,043			8,043	86,663			86,663		94,706
Minnesota	10,241		1,089	11,330	42,420	54,743		97,163	1,330	109,823
Mississippi	9,798			9,798	49,181			49,181	192	59,171
Missouri	7,866	21,999	2	29,867	69,352			69,352	598	99,817

Montana	5,780	5,584	19	11,383	53,369			53,369	7,535	72,287
Nebraska	9,027		214	9,241	67,331	20,143		87,474	284	96,999
Nevada	2,011	4,228		6,239	38,279			38,279	1	44,519
New Hampshire	1,681	2,183	33	3,897		8,812	3	8,815	86	12,798
New Jersey	932		846	1,778	6,681	12,617		19,298		21,076
New Mexico	11,405		6	11,411	45,782			45,782	5,183	62,376
New York	12,400		1,360	13,760	19,330	51,194		70,524	10	84,294
North Carolina	11,548	57,681	188	69,417					1,644	71,061
North Dakota	6,174		25	6,199	17,382	80,461		97,843	547	104,589
Ohio	15,753		241	15,994	29,519	38,802		68,321		84,315
Oklahoma	10,899		394	11,293	83,037		13	83,050		94,343
Oregon	4,469	2,572	1,532	8,573	27,154		7,068	34,222	32,575	75,370
Pennsylvania	12,629	25,474	4,706	42,809	652	45,335		45,987	308	89,104
Rhode Island	684		64	748		603		603		1,351
South Carolina	8,468	19,545	142	28,155	23,968			23,968		52,123
South Dakota	7,744		225	7,969	20,304	54,383		74,687	1,702	84,358
Tennessee	7,883		360	8,243	58,291		27	58,318	883	67,444
Texas	57,019		27	57,046	139,937			139,937		196,983
Utah	5,031			5,031	19,372			19,372	8,377	32,780
Vermont	2,083		60	2,143		10,730		10,730	24	12,897
Virginia	7,676	40,864	96	48,636	719			719	1,716	51,071
Washington	3,882	2,263	3,811	9,956	39,201			39,201	11,571	60,728
West Virginia	4,634	26,218	230	31,082					774	31,856
Wisconsin	10,138		416	10,554	18,716	57,637		76,353	66	86,973
Wyoming	5,422			5,422	15,521		45,060	60,581	3,868	69,871
District of Columbia										
Total	411,076	248,181	22,117	681,374	1,740,596	536,085	67,442	2,344,123	127,080	3,152,577

See footnotes at end of table, p. 249.

TABLE A.—*Total road and street mileage in the United States, 1964—Classified by system*—Continued

State	Municipal mileage					Total rural and municipal mileage
	Under State control			Under local control—Local city streets [5]	Total municipal mileage	
	Extensions of State primary system	Extensions of State secondary roads [1]	Total			
Alabama	1,324	63	1,387	9,138	10,525	76,558
Alaska	112		112	399	511	6,430
Arizona	257		257	5,456	5,713	39,013
Arkansas	890		890	5,986	6,876	80,296
California	1,918		1,918	35,539	37,457	156,007
Colorado	439		439	5,485	5,924	79,584
Connecticut	861	1,317	2,178	10,105	12,283	17,456
Delaware	177	668	845	475	1,320	4,769
Florida	1,568	428	1,996	15,289	17,285	76,941
Georgia	2,129		2,219	11,338	13,467	96,155
Hawaii	49	23	72	765	837	3,271
Idaho	272		272	2,334	2,606	41,854
Illinois	3,101		3,101	22,020	25,121	127,644
Indiana	1,212		1,212	15,965	17,177	104,476
Iowa	1,130		1,130	11,323	12,453	112,104
Kansas	612		612	8,378	8,990	132,627
Kentucky	955		955	3,798	4,753	69,849
Louisiana	671	708	1,379	8,020	9,399	49,831
Maine	363	388	751	1,590	2,341	20,998
Maryland	133	165	298	3,488	3,786	23,092
Massachusetts	1,772		1,772	17,879	19,651	27,014
Michigan	1,205		1,205	17,001	18,206	112,912
Minnesota	1,752		1,752	13,335	15,087	124,910
Mississippi	865		865	5,071	5,936	65,107

Missouri	991	620	1,611	12,584	14,195	114,012
Montana	170	71	241	1,800	2,041	74,328
Nebraska	404		404	5,471	5,875	102,874
Nevada	73	73	146	1,214	1,360	45,879
New Hampshire	222	138	360	1,219	1,579	14,377
New Jersey	1,010		1,010	10,323	11,333	32,409
New Mexico	678		678	2,671	3,349	65,725
New York	1,261		1,261	16,222	17,483	101,777
North Carolina	1,458	1,811	3,269	9,052	12,321	83,382
North Dakota	236		236	2,744	2,980	107,569
Ohio	2,822		2,822	19,001	21,823	106,138
Oklahoma	1,011		1,011	10,191	11,202	105,545
Oregon	344	172	516	4,924	5,440	80,810
Pennsylvania	2,512	2,429	4,941	16,878	21,819	110,923
Rhode Island	293		293	2,864	3,157	4,508
South Carolina	929	2,960	3,889	2,017	5,906	58,029
South Dakota	230		230	2,591	2,821	87,179
Tennessee	1,017		1,017	7,573	8,590	76,034
Texas	5,135		5,135	36,531	41,666	238,649
Utah	656		656	3,455	4,111	36,891
Vermont	73		73	834	907	13,804
Virginia	1,152	652	1,804	5,529	7,333	58,404
Washington	400	188	588	7,597	8,185	68,913
West Virginia	497	164	661	2,383	3,044	34,900
Wisconsin	1,599		1,599	11,297	12,896	99,869
Wyoming	147		147	982	1,129	71,000
District of Columbia				1,243	1,243	1,243
Total	490,87	13,038	62,125	429,367	491,492	3,644,069

[1] Includes mileage of county roads under State control in all counties of Delaware, North Carolina, and West Virginia, 8 counties in Alabama; all but 2 counties in Virginia; ome county mileage in Nevada; mileage designated as farm-to-market in Louisiana; nd the State-aid system in Maine.

[2] Includes mileage of State park, forest, institutional, toll and other roads that are not a art of the State or local highway system.

[3] Mileage not identified by administrative system.

[4] Mileage in Federal parks, forests, and reservations that are not a part of the State highway system.

[5] Includes all roads, streets, and public ways not under State control in: Municipalities; delimited unincorporated places having an estimated population of 1,000 or more; areas which comprise the unincorporated fringe around cities of 50,000 population or greater, defined as urbanized areas by the Bureau of Census in the latest enumeration or as determined by the State highway departments.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1946					1947				
A. Current receipts for highways: [1]										
Highway-user revenue		1,454	1	16	1,471		1,598	1	17	1,616
Tolls		57	7	10	64		60	8	21	89
Property taxes and assessments		1	222	91	314			246	107	353
General fund appropriations		144	61	213	418		31	79	257	367
Federal funds	8				8	12				12
Miscellaneous		16	14	22	52		19	17	32	68
Subtotal	8	1,672	305	352	2,337	12	1,708	351	34	2,505
Transfers in		18	313	78	409		22	359	106	487
Total	8	1,690	618	430	2,746	12	1,730	710	540	2,992
B. Disbursements (fixed charges):										
Maintenance	1	339	373	219	932	4	380	432	265	1,081
Administration and policing	7	132	24	26	189	8	181	27	35	251
Debt service		178	102	106	386		166	101	114	381
Subtotal	8	649	499	351	1,507	12	727	560	414	1,713
Transfers out		388	14	7	409		460	23	4	487
Total	8	1,037	513	358	1,916	12	1,187	583	418	2,200
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		653	105	72	830		543	127	122	792
Federal funds:										
Highway-user revenue										
General funds	170				170	324				324
Miscellaneous	3				3	3				3
Subtotal	173				173	327				327
Transfers	−150	147	3			−290	238	2		
Bond proceeds		57	50	46	153		80	107	122	309
Total	23	857	158	118	1,156	37	911	236	244	1,428

D. Capital outlay by road system:										
Main rural roads		475	3		478		782	7		789
Local rural roads	21	22	142		185	35	65	196		296
Urban streets and highways		35	1	100	136		111	5	212	328
Total	21	532	146	100	799	35	958	208	212	1,413
	1948					1949				
A. Current receipts for highways: [1]										
Highway-user revenue		1,812	1	20	1,833		2,080	2	23	2,105
Tolls		65	10	24	99		71	11	26	108
Property taxes and assessments			267	120	387			291	131	422
General fund appropriations		60	84	325	469		70	81	332	483
Federal funds	13				13	15				15
Miscellaneous		34	20	35	89		41	22	47	110
Subtotal	13	1,971	382	524	2,890	15	2,262	407	559	3,243
Transfers in		29	434	114	577		35	459	154	648
Total	13	2,000	816	638	3,467	15	2,297	866	713	3,891
B. Disbursements (fixed charges):										
Maintenance	5	475	478	324	1,282	5	501	498	347	1,351
Administration and policing	8	171	33	43	255	10	190	38	50	288
Debt service		169	103	117	389		161	104	127	392
Subtotal	13	815	614	484	1,926	15	852	640	524	2,031
Transfers out		539	30	8	577		603	36	9	648
Total	13	1,354	644	492	2,503	15	1,455	676	533	2,679
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		646	172	146	964		842	190	180	1,212
Federal funds:										
Highway-user revenue										
General funds	402				402	492				492
Miscellaneous	5				5	8				8
Subtotal	407				407	500				500
Transfers	−369	365	4			−434	429	5		
Bond proceeds		270	83	122	475		254	100	181	535
Total	38	1,281	259	268	1,846	66	1,525	295	361	2,247

See footnotes at end of table, p. 260.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*—Continued

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1948					1949				
D. Capital outlay by road system:										
Main rural roads		982	10		992		1,108	10		1,118
Local rural roads	37	89	236		362	61	108	250		419
Urban streets and highways		169	9	253	431		272	19	319	610
Total	37	1,240	255	253	1,785	61	1,488	279	319	2,147
	1950					1951				
A. Current receipts for highways:[1]										
Highway-user revenue		2,275	2	23	2,300		2,488	2	25	2,515
Tolls		72	12	31	115		93	12	37	142
Property taxes and assessments			327	154	481			343	145	488
General fund appropriations		39	77	308	424		44	95	323	462
Federal funds	17				17	17				17
Miscellaneous		47	30	54	131		52	31	55	138
Subtotal	17	2,433	448	570	3,468	17	2,677	483	585	3,762
Transfers in		43	489	165	697		51	531	172	754
Total	17	2,476	937	735	4,165	17	2,728	1,014	757	4,516
B. Disbursements (fixed charges):										
Maintenance	6	514	557	346	1,423	6	477	596	378	1,557
Administration and policing	11	192	44	51	298	11	221	47	55	334
Debt service		210	104	139	453		223	104	154	481
Subtotal	17	916	705	536	2,174	17	1,021	747	587	2,372
Transfers out		642	36	19	697		692	49	13	754
Total	17	1,558	741	555	2,871	17	1,713	796	600	3,126

C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		918	196	180	1,294		1,015	218	157	1,390
Federal funds:										
Highway-user revenue										
General funds	475				475	471				471
Miscellaneous	8				8	11				11
Subtotal	483				483	482				482
Transfers	−431	425	6			−425	416	9		
Bond proceeds		402	89	164	655		535	79	180	794
Total	52	1,745	291	344	2,432	57	1,966	306	337	2,666
D. Capital outlay by road system:										
Main rural roads		1,232	13		1,245		1,406	10		1,416
Local rural roads	55	95	236		386	54	97	262		413
Urban streets and highways		321	16	329	666		349	13	337	699
Total	55	1,648	265	329	2,297	54	1,852	285	337	2,528
	1952					1953				
A. Current receipts for highways: [1]										
Highway-user revenue		2,776	3	35	2,814		3,003	3	49	3,055
Tolls		133	13	41	187		146	13	42	201
Property taxes and assessments			377	174	551			403	195	598
General fund appropriations		42	96	347	485		40	111	371	522
Federal funds	19				19	19				19
Miscellaneous		46	40	72	158		66	41	70	177
Subtotal	19	2,997	529	669	4,214	19	3,255	571	727	4,572
Transfers		56	581	188	825		80	615	214	909
Total	19	3,053	1,110	857	5,039	19	3,335	1,186	41	5,481
B. Disbursements (fixed charges):										
Maintenance	7	618	618	409	1,652	7	636	649	442	1,734
Administration and policing	12	229	51	70	362	12	260	56	70	398
Debt service		237	104	149	490		241	108	163	512
Subtotal	19	1,084	773	28	2,504	19	1,137	813	675	2,644
Transfers out		757	49	19	825		818	69	22	909
Total	19	1,841	822	647	3,329	19	1,955	882	697	3,553

See footnotes at end of table, p. 260.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*—Continued

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1952					1953				
C. Funds for capital outlay:[1]										
Excess current revenues (A less B)		1,212	288	210	1,710		1,380	304	244	1,928
Federal funds:										
Highway-user revenue										
General funds	535				535	620				620
Miscellaneous	20				20	21				21
Subtotal	555				555	641				641
Transfers	−503	485	17	1		−560	541	18	1	
Bond proceeds		797	103	209	1,109		1,037	106	203	1,346
Total	52	2,494	408	420	3,374	81	2,958	428	448	3,915
D. Capital outlay by road system:										
Main rural roads		1,584	13		1,597		1,802	14		1,816
Local rural roads	62	132	324		518	74	145	368		587
Urban streets and highways		374	18	379	771		488	19	415	922
Total	62	2,090	355	379	2,886	74	2,435	401	415	3,325
	1954					1955				
A. Current receipts for highways:[1]										
Highway-user revenue		3,244	4	49	3,297		3,583	4	56	3,643
Tolls		167	14	43	224		209	15	46	270
Property taxes and assessments			420	222	642			438	240	678
General fund appropriations		56	106	376	538		53	99	404	556
Federal funds	19				19	19				19
Miscellaneous		51	40	73	164		98	48	76	222
Subtotal	19	3,518	584	763	4,884	19	3,943	604	822	5,388
Transfers in		65	152	245	962		87	671	261	1,019
Total	19	3,583	1,236	1,008	5,846	19	4,030	1,275	1,083	6,407

B. Disbursements (fixed charges):										
Maintenance	7	664	677	456	1,804	7	693	701	480	1,881
Administration and policing	12	294	59	72	437	12	297	64	82	455
Debt service		318	110	207	635		380	110	195	685
Subtotal	19	1,276	846	735	2,876	19	1,370	875	757	3,021
Transfers out		883	61	18	952		913	74	32	1,019
Total	19	2,159	907	753	3,838	19	2,283	949	789	4,040
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		1,424	329	255	2,008		1,747	32	294	2,367
Federal funds:										
Highway-user revenue										
General fund	63				663	751				751
Miscellaneous	18				18	21				21
Subtotal	681				681	772				772
Transfers	−607	588	18	1		−687	70	17		
Bond proceeds		2,317	95	254	2,666		4	206	335	1,185
Total	74	4,329	442	510	5,355	85	3,0 1	549	629	4,324
D. Capital outlay by road system:										
Maintenance rural roads		2 366	22		2,388		2,412	23		2,435
Local rural roads	75	147	394		616	78	170	413		661
Urban streets and highways		621	20	65	1,106		718	13	507	1,238
Total	75	3 134	436	465	4,110	78	3,300	449	507	4,334
	1956					1957				
A. Current eceipts for highways: [1]										
Highway-user revenue		3,909	3	57	3,969		4,062	5	68	4,135
Tolls		251	15	49	315		290	16	52	358
Property taxes and assessments			464	258	722			4 4	333	817
General fund appropriations		112	113	425	650		38	111	398	547
Federal funds	20				20	41				41
Miscellaneous		114	52	9	258		124	54	87	265
Subtotal	20	4,386	647	881	5,934	41	4,514	670	938	6,163
Transfers in		76	725	284	1,085		92	779	335	1,206
Total	20	4,462	1,372	1,165	7,019	41	4,606	1,449	1,273	7,369

See footnotes at end of table, p. 260.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*—Continued

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1956					1957				
B. Disbursements (fixed charges):										
Maintenance	8	775	764	542	2,089	24	830	784	567	2,205
Administration and policing	12	340	65	105	522	17	412	76	123	628
Debt service		419	119	190	728		481	124	241	846
Subtotal	20	1,534	948	837	3,339	41	1,723	984	931	3,679
Transfers out		988	71	26	1,085		1,083	82	41	1,206
Total	20	2,522	1,019	863	4,424	41	2,806	1,066	972	4,885
C. Funds for Capital outlay:[1]										
Excess current revenues (A less B)		1,940	353	302	2,595		1,800	383	301	2,484
Federal funds:										
Highway-user revenue	632				632	1,936				1,936
General funds	371				371	135				135
Miscellaneous	25				25	33				33
Subtotal	1,028				1,028	2,104				2,104
Transfers	−797	776	21			−1,284	1,256	28		
Bond proceeds		1,067	102	313	1,482		701	123	365	1,189
Total	231	3,783	475	615	5,105	820	3,757	534	666	5,777
D. Capital outlay by road system:										
Main rural roads		2,745	26		2,771		2,987	30		3,017
Local rural roads	87	208	438		733	130	229	465		824
Urban streets and highways		938	10	563	1,511		1,175	23	615	1,813
Total	87	3,891	474	563	5,015	130	4,391	518	615	5,654
	1958					1959				
A. Current receipts for highways:[1]										
Highway-user revenue		4,198	4	62	4,264		4,428	9	66	4,503
Tolls		325	19	53	397		396	20	54	470
Property taxes and assessments			521	358	879			512	389	901
General fund appropriations		57	145	374	576		48	153	346	547
Federal funds	46				46	55				55
Miscellaneous		124	60	116	300		135	49	135	319

Subtotal	46	4,704	749	963	6,462	55	5,007	743	990	6,795
Transfers in		104	777	389	1,270		115	815	401	1,331
Total	46	4,808	1,526	1,352	7,732	55	5,122	1,558	1,391	8,126
B. Disbursements (fixed charges):										
Maintenance	24	886	846	613	2,369	25	923	874	659	2,481
Administration and policing	22	467	81	155	725	30	505	91	134	760
Debt service		508	126	260	894		579	124	285	988
Subtotal	46	1,861	1,053	1,028	3,988	55	2,007	1,089	1,078	4,229
Transfers out		1,126	102	42	1,270		1,176	100	55	1,331
Total	46	2,987	1,155	1,070	5,258	55	3,183	1,189	1,133	5,560
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		1,821	371	282	2,474		1,939	369	258	2,566
Federal funds:										
Highway-user revenues	1,969				1,969	2,221				2,221
General funds	140				140	125				125
Miscellaneous	31				31	27				27
Subtotal	2,140				2,140	2,373				2,373
Transfers	−2,273	2,247	26			−3,080	3,059	21		
Bond proceeds		913	140	299	1,352		669	153	336	1,158
Total	[2] −133	4,981	537	581	5,966	[2] −707	5,667	543	594	6,097
D. Capital outlay by road system:										
Main rural roads		3,462	23		3,485		3,605	22		3,627
Local rural roads	135	259	499		893	103	279	474		856
Urban streets and highways		1,287	27	656	1,970		1,518	25	631	2,174
Total	135	5,008	549	656	6,348	103	5,402	521	631	6,657
	1960					1961				
A. Current receipts for highways: [1]										
Highway-user revenue		4,731	9	70	4,810		4,868	8	67	4,943
Tolls		426	19	54	499		450	16	53	519
Property taxes and assessments			513	340	853			521	378	899
General fund appropriations		54	170	438	662		80	192	489	761
Federal funds	61				61	61				61
Miscellaneous		164	52	164	380		165	55	154	374
Subtotal	61	5,375	763	1,066	7,265	61	5,563	792	1,141	7,557
Transfers in		101	847	413	1,361		111	918	410	1,439
Total	61	5,476	1,610	1,479	8,626	61	5,674	1,710	1,551	8,996

ee footnotes at end of table, p. 260.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*—Continued

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1960					1961				
B. Disbursements (fixed charges):										
Maintenance	27	1,006	922	685	2,640	28	1,040	922	738	2,728
Administration and policing	30	532	96	152	810	33	575	100	162	870
Debt service	4	604	117	296	1,021	----------	636	157	301	1,094
Subtotal	61	2,142	1,135	1,133	4,471	61	2,251	1,179	1,201	4,692
Transfers out	----------	1,235	78	48	1,261	----------	1,281	103	55	1,439
Total	61	3,377	1,213	1,181	5,832	61	3,532	1,282	1,256	6,131
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)	----------	2,099	397	298	2,794	----------	2,142	428	295	2,865
Federal funds:										
Highway-user revenues	2,803	----------	----------	----------	2,803	2,808	----------	----------	----------	2,808
General funds	160	----------	----------	----------	160	172	----------	----------	----------	172
Miscellaneous	39	----------	----------	----------	39	42	----------	----------	----------	42
Subtotal	3,002	----------	----------	----------	3,002	3,002	----------	----------	----------	3,022
Transfers	−2,551	2,521	28	2	----------	−2,741	2,710	29	2	----------
Bond proceeds	----------	680	85	454	1,219	----------	718	153	401	1,272
Total	451	5,300	510	754	7,015	281	5,570	610	698	7,159
D. Capital outlay by road systems:										
Main rural roads	----------	3,294	12	----------	3,306	----------	3,487	59	----------	3,546
Local rural roads	141	237	475	----------	853	139	245	491	----------	875
Urban streets and highways	----------	1,452	13	666	2,131	----------	1,705	28	646	2,379
Total	141	4,983	500	666	6,290	139	5,437	578	646	6,800
	1962					1963				
A. Current receipts for highways: [1]										
Highway-user revenue	----------	5,155	9	67	5,231	----------	5,363	10	63	5,436
Tolls	----------	480	16	58	554	----------	497	17	60	574
Property taxes and assessments	----------	----------	527	397	924	----------	----------	564	407	971
General fund appropriations	----------	73	207	466	746	----------	50	209	508	767
Federal funds	64	----------	----------	----------	64	52	----------	----------	----------	52
Miscellaneous	----------	179	58	161	398	----------	208	58	177	443

Subtotal	64	5,887	817	1,149	7,917	52	6,118	858	1,215	8,243
Transfers in		114	925	451	1,490		102	966	485	1,553
Total	64	6,001	1,742	1,600	9,407	52	6,220	1,824	1,700	9,796
B. Disbursements (fixed charges):										
Maintenance	29	1,113	939	758	2,839	12	1,158	959	789	2,918
Administration and policing	35	623	99	163	920	40	670	109	190	1,009
Debt service		686	151	320	1,157		743	159	330	1,232
Subtotal	64	2,422	1,189	1,241	4,916	52	2,571	1,227	1,309	5,159
Transfers out		1,324	113	53	1,490		1,398	109	46	1,553
Total	64	3,746	1,302	1,294	6,406	52	3,969	1,336	1,355	6,712
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		2,255	440	306	3,001		2,251	488	345	3,084
Federal funds:										
Highway-user revenue	3,060				3,060	3,379				3,379
General funds	191				191	245				245
Miscellaneous	49				49	57				57
Subtotal	3,300				3,300	3,681				3,681
Transfers	−2,945	2,914	30	1		−3,514	3,479	30	5	
Bond proceeds		1,017	184	334	1,535		458	114	409	981
Total	355	6,186	654	641	7,836	167	6,188	632	759	7,746
D. Capital outlay by road systems:										
Main rural roads		3,627	47		3,674		3,999	22		4,021
Local rural roads	164	241	520		925	193	270	546		1,009
Urban streets and highways		2,068	39	680	2,787		2,120	50	693	2,863
Total	164	5,936	606	680	7,386	193	6,389	618	693	7,893
	1964					1965				
A. Current receipts and highways: [1]										
Highway-user revenue		5,696	10	64	5,770		6,083	10	64	6,157
Tolls		537	17	62	616		569	18	62	649
Property taxes and assessments			597	432	1,029			616	446	1,062
General fund appropriations		57	212	514	783		62	220	525	807
Federal funds	62				62	67				67
Miscellaneous		263	57	167	487		282	57	168	507
Subtotal	62	6,553	893	1,239	8,747	67	6,996	921	1,265	9,249
Transfers in		112	1,046	570	1,728		116	1,120	600	1,836
Total	62	6,665	1,939	1,809	10,475	67	7,112	2,041	1,865	11,085

See footnotes at end of table, p. 260.

TABLE B.—*Receipts and disbursements for highways by all units of government, 1946–65*—Continued

[In millions of dollars]

	Federal Government	State agencies	Counties and townships	Municipalities	Total	Federal Government	State agencies	Counties and townships	Municipalities	Total
	1964					1965				
B. Disbursements (fixed charges):										
Maintenance	15	1,236	1,022	838	3,111	18	1,363	1,069	881	3,331
Administration and policing	47	772	116	201	1,136	49	830	122	211	1,212
Debt service		754	165	342	1,261		783	172	353	1,308
Subtotal	62	2,762	1,303	1,381	5,508	67	2,976	1,363	1,445	5,851
Transfers out		1,562	115	51	1,728		1,666	117	53	1,836
Total	62	4,324	1,418	1,432	7,236	67	4,642	1,480	1,498	7,687
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		2,341	521	337	3,239		2,470	561	367	3,398
Federal funds:										
Highway-user revenue	3,536				3,536	3,740				3,740
General funds	247				247	307				307
Miscellaneous	55				55	61				61
Subtotal	3,838				3,838	4,108				4,108
Transfers	−4,029	3,978	36	15		−3,998	3,942	39	17	
Bond proceeds		634	114	411	1,159		640	115	415	1,170
Total	[2] −191	6,953	671	803	8,236	110	7,052	715	799	8,676
D. Capital outlay by road systems:										
Main rural roads		4,093	22		4,115		4,038	24		4,062
Local rural roads	179	266	590		1,035	163	272	616		1,051
United streets and highways		2,331	36	726	3,093		2,290	38	729	3,057
Total	179	6,690	648	726	8,243	163	6,600	678	729	8,170

[1] Included in pt. A are all funds available for highways except Federal funds and bond proceeds applied to capital outlay. These funds are included only in pt. C.
[2] Funds to meet these deficits were drawn from reserves.

TABLE C.—*1964 mileage classified by administrative and by Federal-aid systems*

Highways eligible for Federal-aid funds	State administered highways	County and township roads	Local municipal streets	Federal domain roads	Total
On Federal-aid systems:					
Interstate rural	34,318	9	12		34,339
Interstate urban	6,583	3	220		6,806
Other FAP rural	187,083	676	174	237	188,170
Other FAP urban	17,680	48	1,230	21	18,979
Secondary rural	298,781	301,064	7,173	109	607,127
Secondary urban	8,328	3,554	7,335		19,217
Total	552,773	305,354	16,144	367	874,638
Not on Federal-aid systems:					
Rural	181,364	2,039,597		126,713	2,347,674
Municipal	12,999		414,719		427,718
Total	194,363	2,039,597	414,719	126,713	2,775,392
Grand total [1]	747,136	2,344,951	430,863	127,080	3,650,030

[1] Includes mileage in Puerto Rico, and thus exceeds totals in table A.

TABLE D.—*1964 highway capital expenditures by State agencies, by administrative and by Federal-aid systems*

[In millions of dollars]

Highways eligible for Federal-aid funds	State administered highways	County and township roads	Local municipal streets	Federal domain roads	Total
On Federal-aid systems:					
Interstate rural	1,872				1,872
Interstate urban	1,468		26		1,494
Other FAP rural	1,304				1,304
Other FAP urban	741		13		754
Secondary rural	590	210			800
Secondary urban	14		12		26
Total	5,989	210	51		6,250
Not on Federal-aid systems:					
Rural	342	56			398
Municipal	31		11		42
Total	373	56	11		440
Grand total	6,362	266	62		6,690

TABLE E.—*1964 highway capital expenditures by all units of government, by administrative and by Federal-aid systems*

[In millions of dollars]

Highways eligible for Federal-aid funds	State administered highways	County and township roads	Local municipal streets	Federal domain roads	Total
On Federal-aid systems:					
Interstate rural	1,873				1,873
Interstate urban	1,513		26		1,539
Other FAP rural	1,306	10			1,316
Other FAP urban	746		23		769
Secondary rural	616	251	29		896
Secondary urban	14		24		38
Total	6,068	261	102		6,431
Not on Federal-aid systems:					
Rural	349	595		168	1,112
Municipal	33		667		700
Total	382	595	667	168	1,812
Grand total	6,450	856	769	168	8,243

TABLE F.—*Receipts and disbursements for highways by all units of government—Forecast, 1966–75*

[In millions of dollars]

	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total
	1966					1967				
A. Current receipts for highways: [1]										
Highway-user revenue	----------	6,454	10	65	6,529	----------	6,783	8	73	6,864
Tolls	----------	597	18	63	678	----------	630	18	64	712
Property taxes and assessments	----------	----------	626	469	1,095	----------	----------	661	478	1,139
General fund appropriations	----------	65	230	535	830	----------	72	230	563	865
Federal funds	67	----------	----------	----------	67	69	----------	----------	----------	69
Miscellaneous	----------	300	57	168	525	----------	309	62	181	552
Subtotal	67	7,416	941	1,300	9,724	69	7,794	979	1,359	10,201
Transfers in	----------	121	1,198	639	1,958	----------	124	+1,266	+667	2,057
Total	67	7,537	2,139	1,939	11,682	69	7,918	2,245	2,026	12,25
B. Disbursements (fixed charges):										
Maintenance	18	1,432	1,124	925	3,499	19	1,499	1,182	980	3,680
Administration and policing	49	878	128	223	1,278	50	922	134	234	1,340
Debt service	----------	810	180	363	1,353	----------	838	182	379	1,399
Subtotal	67	3,120	1,432	1,511	6,130	69	3,259	1,498	1,593	6,419
Transfers out	----------	1,783	120	55	1,958	----------	1,879	122	56	2,057
Total	67	4,903	1,552	1,566	8,088	69	5,138	1,620	1,649	8,476
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)	----------	2,634	587	373	3,594	----------	2,780	625	377	3,782
Federal funds:										
Highway-user revenue	3,888	----------	----------	----------	3,888	4,041	----------	----------	----------	4,041
General funds	498	----------	----------	----------	498	505	----------	----------	----------	505
Miscellaneous	51	----------	----------	----------	51	48	----------	----------	----------	48
Subtotal	4,437	----------	----------	----------	4,437	4,594	----------	----------	----------	4,594
Transfers out	−4,158	+4,119	+35	+4	----------	−4,408	+4,368	+35	+5	----------
Bond proceeds	----------	873	118	422	1,413	----------	800	121	429	1,350
Total	279	7,626	740	799	9,444	186	7,948	781	811	9,726

D. Capital outlay by road systems:										
Main rural roads		4,381	24		4,405		4,687	29		4,716
Local rural roads	187	293	641		1,121	186	326	667		1,179
Urban streets and highways		2,463	40	731	3,234		2,622	34	769	3,425
Total	187	7,137	705	731	8,760	186	7,635	730	769	9,320
	1968					1969				
A. Current receipts for highways: [1]										
Highway-user revenue		7,076	8	74	7,158		7,368	8	75	7,451
Tolls		662	18	65	745		698	18	66	782
Property taxes and assessments			679	491	1,170			696	504	1,200
General fund appropriations		73	231	565	869		74	231	565	870
Federal funds	71				71	72				72
Miscellaneous		318	60	181	559		327	58	182	567
Subtotal	71	8,129	996	1,376	10,572	72	8,467	1,011	1,392	10,942
Transfers in		127	1,325	696	2,148		130	1,382	725	2,237
Total	71	8,256	2,321	2,072	12,720	72	8,597	2,393	2,117	13,179
B. Disbursements (fixed charges):										
Maintenance	19	1,588	1,209	1,024	3,840	20	1,671	1,249	1,070	4,010
Administration and policing	52	968	140	246	1,406	52	1,011	147	257	1,467
Debt service		882	186	388	1,456		925	188	394	1,507
Subtotal	71	3,438	1,535	1,658	6,702	72	3,607	1,584	1,721	6,984
Transfers out		1,967	123	58	2,148		2,052	126	59	2,237
Total	71	5,405	1,658	1,716	8,850	72	5,659	1,710	1,780	9,221
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		2,851	663	356	3,870		2,938	683	337	3,958
Federal funds:										
Highway-user revenue	4,189				4,189	4,305				4,305
General fund	591				591	610				610
Miscellaneous	48				48	50				50
Subtotal	4,828				4,828	4,965				4,965
Transfers out	−4,638	+4,597	+36	+5		−4,770	+4,728	+37	+5	
Bond proceeds		725	121	429	1,275		650	121	429	1,200
Total	190	8,173	820	790	9,973	195	8,316	841	771	10,123

See footnote at end of table, p. 267.

TABLE F.—*Receipts and disbursements for highways by all units of government—Forecast, 1966–75*—Continued

	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total
	1968					1969				
D. Capital outlay by road systems:										
Main rural roads		4,903	34		4,937		4,990	37		5,027
Local rural roads	190	345	690		1,225	195	350	717		1,262
Urban streets and highways		2,743	34	807	3,584		2,791	36	835	3,662
Total	190	7,991	758	807	9,746	195	8,131	790	835	9,951
	1970					1971				
A. Current receipts for highways: [1]										
Highway-user revenue		7,660	8	76	7,744		7,950	8	77	8,035
Tolls		732	19	66	817		755	19	67	841
Property taxes and assessments			708	512	1,220			725	525	1,250
General fund appropriations		75	232	568	875		76	234	572	882
Federal funds	74				74	75				75
Miscellaneous		337	58	185	580		346	58	188	592
Subtotal	74	8,804	1,025	1,407	11,310	75	9,127	1,044	1,429	11,675
Transfers in		132	1,442	754	2,328		134	1,499	782	2,415
Total	74	8,936	2,467	2,161	13,638	75	9,261	2,543	2,211	14,090
B. Disbursements (fixed charges):										
Maintenance	20	1,769	1,288	1,112	4,189	21	1,879	1,320	1,173	4,393
Administration and policing	54	1,050	152	268	1,524	54	1,090	158	278	1,580
Debt service		949	193	402	1,544		980	195	407	1,582
Subtotal	74	3,768	1,633	1,782	7,257	75	3,949	1,673	1,858	7,555
Transfers out		2,141	127	60	2,328		2,226	128	61	2,415
Total	74	5,909	1,760	1,842	9,585	75	6,175	1,801	1,919	9,970

C. Funds for capital outlay: [1]										
Excess current revenues (A less B)	----------	3,027	707	319	4,053	----------	3,086	742	292	4,120
Federal funds:										
Highway-user revenue	4,408	----------	----------	----------	4,408	4,509	----------	----------	----------	4,509
General fund	619	----------	----------	----------	619	568	----------	----------	----------	568
Miscellaneous	50	----------	----------	----------	50	51	----------	----------	----------	51
Subtotal	5,077	----------	----------	----------	5,077	5,128	----------	----------	----------	5,128
Transfers out	−4,882	+4,839	+38	+5	----------	−4,928	+4,884	+39	+5	----------
Bond proceeds	----------	650	123	437	1,210	----------	600	123	437	1,160
Total	195	8,516	868	761	10,340	200	8,570	904	734	10,408
D. Capital outlay by road systems:										
Main rural roads	----------	5,075	38	----------	5,113	----------	5,119	37	----------	5,156
Local rural roads	195	360	737	----------	1,292	200	360	758	----------	1,318
Urban streets and highways	----------	2,851	37	865	3,753	----------	2,877	38	884	3,799
Total	195	8,286	812	865	10,158	200	8,356	833	884	10,273
	1972					1973				
A. Current receipts for highways: [1]										
Highway-user evenue	----------	8,240	9	77	8,326	----------	8,543	9	78	8,630
Tolls	----------	778	19	68	865	----------	801	19	69	889
Property taxes and assessments	----------	----------	745	540	1,285	----------	----------	766	554	1,320
General fund appropriations	----------	77	236	579	892	----------	78	239	586	903
Federal funds	76	----------	----------	----------	76	77	----------	----------	----------	77
Miscellaneous	----------	354	62	197	613	----------	362	63	199	624
Subtotal	76	9,449	1,071	1,461	12,057	77	9,784	1,096	1,486	12,443
Transfers in	----------	136	1,559	811	2,506	----------	138	1,619	841	2,598
Total	76	9,585	2,630	2,272	14,563	77	9,922	2,715	2,327	15,041
B. Disbursements (fixed charges):										
Maintenance	21	2,004	1,352	1,236	4,613	22	2,141	1,383	1,284	4,830
Administration and policing	55	1,128	1 4	287	1,634	55	1,165	169	297	1,686
Debt service	----------	992	197	411	1,600	----------	1,014	201	418	1,633
Subtotal	76	4,124	1,713	1,934	7,847	77	4,320	1,753	1,999	8,149
Transfers out	----------	2,315	130	61	2,506	----------	2,405	131	62	2,598
Total	76	6,439	1,843	1,995	10,353	77	6,725	1,884	2,061	10,747

See footnote at end of table, p. 267.

TABLE F.—*Receipts and disbursements for highways by all units of government—Forecast, 1966–75*—Continued

	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total	Federal Government	State agencies and District of Columbia	Counties and townships	Municipalities	Total
	1972					1973				
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		3,146	787	277	4,210		3,197	831	266	4,294
Federal funds:										
Highway-user revenue	4,617				4,617	4,731				4,731
General fund	518				518	517				517
Miscellaneous	52				52	53				53
Subtotal	5,187				5,187	5,301				5,301
Transfers out	−4,987	+4,942	+39	+6		−5,050	+5,050	+39	+7	
Bond proceeds		550	123	437	1,110		550	125	445	1,120
Total	200	8,638	949	720	10,507	205	8,797	995	718	10,715
D. Capital outlay by road systems:										
Main rural roads		5,151	33		5,184		5,234	34		5,268
Local rural roads	200	363	784		1,347	205	369	805		1,379
Urban streets and highways		2,894	39	890	3,823		2,955	40	911	3,906
Total	200	8,408	856	890	10,354	205	8,558	879	911	10,553
	1974					1975				
A. Current receipts for highways: [1]										
Highway-user revenue		8,850	9	79	8,938		9,154	9	80	9,243
Tolls		825	20	69	914		848	20	70	938
Property taxes and assessments			789	571	1,360			812	588	1,400
General fund appropriations		80	245	599	924		82	252	616	950
Federal funds	78				78	79				79
Miscellaneous		371	65	206	642		379	65	209	653

Subtotal	78	10,126	1,128	1,524	12,856	79	10,463	1,158	1,563	13,263
Transfers in		140	1,683	872	2,695		142	1,744	902	2,788
Total	78	10,266	2,811	2,396	15,551	79	10,605	2,902	2,465	16,051
B. Disbursements (fixed charges):										
Maintenance	22	2,291	1,415	1,334	5,062	23	2,457	1,446	1,380	5,306
Administration and policing	56	1,206	174	310	1,746	56	1,247	181	318	1,802
Debt service		1,027	203	422	1,652		1,048	206	430	1,684
Subtotal	78	4,524	1,792	2,066	8,460	79	4,752	1,833	2,128	8,792
Transfers out		2,500	132	63	2,695		2,591	133	64	2,788
Total	78	7,024	1,924	2,129	11,155	79	7,343	1,966	2,192	11,580
C. Funds for capital outlay: [1]										
Excess current revenues (A less B)		3,242	887	267	4,396		3,262	936	273	4,471
Federal funds:										
Highway-user revenue	4,837				4,837	4,929				4,929
General fund	492				492	545				545
Miscellaneous	54				54	55				55
Subtotal	5,383				5,383	5,529				5,529
Transfers out	−5,178	+5,131	+39	+8		−5,319	+5,271	+39	+9	
Bond proceeds		525	125	445	1,095		500	125	445	1,070
Total	205	8,898	1,051	720	10,874	210	9,033	1,100	727	11,070
D. Capital outlay by road systems:										
Main rural roads		5,309	35		5,344		5,350	36		5,386
Local rural roads	205	377	826		1,408	210	377	847		1,434
Urban streets and highways		2,996	41	933	3,970		3,035	43	949	4,027
Total	205	8,682	902	933	10,722	210	8,762	926	949	10,847

[1] Included in part A are all funds available for highways *except* Federal funds and bond proceeds applied to capital outlay. These funds are included only in part C.

TABLE G.—*Forecast of capital requirements and capital outlays, 1966–75*

[In millions of dollars]

	Capital requirements	Capital outlays	Amounts requirements exceed outlays
By State governments:			
Main rural roads	55,280	50,199	5,081
Local rural roads	6,104	5,493	611
Urban streets and highways	31,510	28,227	3,283
Total	92,894	83,919	8,975
By local governments:			
Main rural roads	435	337	98
Local rural roads	13,437	7,472	5,965
Urban streets and highways	18,885	8,956	9,929
Total	32,757	16,765	15,992
Total:			
Main rural roads	55,715	50,536	5,179
Local rural roads	19,541	12,965	6,576
Urban streets and highways	50,395	37,183	13,212
Total	125,651	100,684	24,967

Chapter 11

Toll Bridges, Tunnels and Turnpikes*

Introduction

Toll facilities have made up important segments of the transportation system of the United States since pre-Revolutionary days. In Connecticut, for example, a toll ferry crossing between Rocky Hill and Glastonbury has been in continuous operation since 1655—121 years before the Declaration of Independence.

Although many ferries still survive, when we speak of toll facilities in our day we are more likely to mean turnpikes, bridges, and tunnels for the use of which a direct user fee is charged. In one sense, there is no basic difference among these three types of facilities. A turnpike is a highway over land; a bridge is usually a highway over water: and a tunnel is usually a highway under water.

But in the development of Federal and State law applicable to these facilities, some important distinctions have been made over the years and it is necessary to go back into history to understand and appreciate these.

A. Nature and Composition of Facilities

I. TOLL ROADS

1. BRIEF HISTORY

The first turnpikes in this country were direct descendants of those in England and they reached their first full flowering after the American Revolution. The principal reason was that neither the new Republic nor its individual States was able to assume the financial burden of providing the transport facilities needed to bind the young Nation together.

In 1792, Pennsylvania pioneered in the field by authorizing incorporation of a company to build and operate a road from Lancaster to the port of Philadelphia. The turnpike was completed 4 years later and its success prompted similar projects in other areas. In the next quarter century, State legislatures chartered hundreds of private turnpike companies and some 8,000 miles of roads were constructed The bubble burst in the 1830's under the competition from canals and railroads, coupled with the high cost of maintaining and operating the turnpikes. The toll roads gradually fell into disrepair except where the citizenry kept portions open for local use. Toll bridges, with relatively lower maintenance costs and fewer competing facilities, fared better financially.

Between 1843 and 1857 some of the States became fascinated with plank roads and during that period over $10 million in bonds were issued to build more than 7,000 miles of these all-weather roads.

*Prepared by the International Bridge, Tunnel, & Turnpike Association, with minor editing by committee staff.

The plank roads declined and practically disappeared by the 1860's when it became evident that the pavement needed replacement after about 5 years. Moreover, the public became concerned about the abandonment of turnpikes with no provision for incorporating them into the system of public roads.

The development of the automobile revolutionized not only transportation, but also the means of financing the needed roads. In 1901, New York initiated the annual motor vehicle registration fee.

The original Federal-Aid Road Act of 1916 for the first time made Federal funds available to the States as assistance in providing roads. Section 1 of that act provided "that all roads constructed under the provisions of this act shall be free from tolls of all kinds." Section 2 provided that "necessary bridges and culverts shall be deemed parts of the respective roads covered by the provisions of this act."

In 1919 the first motor fuel tax was enacted in Oregon and in 1932 the first Federal gasoline tax was imposed. Between 1920 and 1940, something like 1 million miles of highways were built or improved, mostly from the proceeds of highway user taxes of various kinds.

The Federal statutes and policies relative to toll facilities were reemphasized in the Federal Highway Act of 1921 and in much subsequent legislation. Despite the opposition to toll roads the first modern toll road—the Pennsylvania Turnpike—was built almost entirely with Federal assistance. It was opened to traffic between the vicinities of Harrisburg and Pittsburgh on October 1, 1940.

Thus there was some inconsistency in Federal policy toward aid to toll roads during this period; with the Bureau continuing to oppose the use of Federal-aid funds on such projects while other agencies were providing assistance. However, assistance by such agencies as WPA, PWA, and RFC was more likely prompted by the policy of supporting projects that would create a demand for materials and employment during times of economic distress, than from any endorsement, *per se*, of the toll method of financing.[1]

The success of the Pennsylvania Turnpike created a postwar boom in toll road financing and by the mid-1950's some 30 States had built, were building, or were planning toll roads. The boom apparently reached an end in 1956 with passage of the Federal-aid Highway Act of that year. This provided for 90 percent Federal financing of the 41,000-mile Interstate System and a substantial increase in Federal funds available for the "regular" highway networks.

On the surface, it appeared that a Federal contribution of 90 cents on the dollar to build new, limited access highways through the most heavily traveled traffic corridors would discourage any further substantial private investment in toll roads or, for that matter, in bridges and tunnels on interstate routes. This proved to be a false assumption as will be shown later.

The 1956 act

The Federal-aid Highway Act of 1956 authorized the inclusion of toll roads, bridges, and tunnels in the Interstate System where they met the standards. The historic prohibition on the use of Federal funds for construction, reconstruction, or improvement of toll roads was continued, but the legislation blazed some new trails in Federal policy by permitting Federal funds to be used for approaches to toll roads. It provided:

[1] "A Review of Federal Statutes and Policies on Highway Toll Facilities," U.S. Department of Commerce, Bureau of Public Roads.

1. Federal-aid funds may be expended on projects "approaching any toll road, bridge, or tunnel to a point where such project will have some use irrespective of its use for such toll road, bridge, or tunnel."

2. Interstate System funds may be expended on projects "approaching any toll road on the Interstate System, although the project has no use other than an approach to such toll road: Provided, that agreement satisfactory to the Secretary of Commerce has been reached with the State prior to the approach of any such project—

(1) that the section of toll road will become free to the public upon the collection of tolls sufficient to liquidate the cost of the toll road or any bonds outstanding at the time constituting a valid lien against such toll road covered in the agreement and their maintenance and operation and debt service during the period of toll collections, and

(2) that there is one or more reasonably satisfactory alternate free route available to traffic by which the toll section of the System may be bypassed.

This recital of some of the Federal legislation affecting toll facilities has been made because of its direct bearing in many cases on past, present, and future financing of such facilities.

2. EXISTING CAPITAL PLANT

(a) *Growth and Distribution*

According to information available to the International Bridge, Tunnel & Turnpike Association, there are now 58 toll roads. Of this total, 20 are considered in a special classification because they are comparatively short in length, were designed for special purposes including seasonal tourist-recreational use. This report is centered on the 38 toll roads which are considered a full-fledged part of the public highway system.

Prior to 1900, there were only three toll roads constructed, all of which fall into the scenic, seasonal, or recreational class. Their total cost was $305,000. From 1900 through 1919, there are no toll roads recorded as being constructed.

From 1920 through 1929, four toll roads costing $10,358,000 were constructed: the Wantagh Parkway, the Saw Mill River Parkway, and the Hutchinson River Parkway in New York State, and the Broadmoor-Cheyenne Mountain Scenic Highway in Colorado. However, the Saw Mill River Parkway and the Hutchinson River Parkway did not become toll facilities until 1947, when toll stations were installed and tolls collected for the first time.

In 1934 construction was begun on the Merritt Parkway in Connecticut, which incorporated the first features of modern design. Through 1939, several other parkways were constructed in the State of New York at a cost of over $8,238,000 to bring the total toll road investment by 1940 to $29,638,000.

From 1940 to 1949, five toll roads were built; the Wilbur Cross Parkway in Connecticut, the first sections of the Pennsylvania and Maine turnpikes, the Buccaneer Trail in Florida and the recreational Equinox Skyline Drive in Vermont, at a total combined cost of $113,791,000.

The greatest period for construction of toll roads in the United States was from 1950 through 1959, when a total investment of over

$4,817,669,000 was recorded. This pace slowed briefly upon passage of the 1956 Highway Act, but following 1960, there was a resurgence in the construction of toll roads, and new investment totaling $571,366,000 was recorded between 1960 and 1965.

The grand total of the investment in all 58 toll roads in the United States on which information is available up through 1965 is slightly in excess of $5,538,762,000. Table I shows the 38 major toll roads by name, State, year of completion, and mileage.

TABLE I

Toll road	State	Miles	Year completed
Connecticut Turnpike	Connecticut	129	1958.
Merritt and Wilbur Cross Parkways	do	66	1940.
Denver-Boulder Turnpike	Colorado	17	1952.
Delaware Turnpike (John F. Kennedy Memorial Highway).	Delaware	11	1963.
Airport expressway	Florida	8	1961.
Buccaneer Trail	do	15	1950.
Sunshine State Parkway	do	265	1956—110 miles. 1964—155 miles.
Illinois Tollway	Illinois	187	1958.
Indiana east-west toll road	Indiana	156	1956.
Kansas City Expressway	Kansas	5	1959.
Kansas Turnpike	do	236	1956.
Kentucky Turnpike	Kentucky	40	1956.
Bluegrass Parkway	do	65	1965.
Mountain Parkway	do	43	1963.
Mountain Parkway extension	do	32	1963.
Western Kentucky Parkway	do	127	1963.
Maine Turnpike	Maine	106	1947—43 miles. 1955—63 miles.
John F. Kennedy Memorial Highway	Maryland	42	1963.
Massachusetts Turnpike	Massachusetts	123	1957.
Boston extension	do	12	1965.
New Hampshire Turnpike	New Hampshire	15	1950.
Everett Turnpike	do	40	1957.
Spaulding Turnpike	do	25	1957.
Atlantic City Expressway	New Jersey	44	1964.
New Jersey Turnpike	do	131	1951.
Garden State Parkway	do	173	1954.
New York State Thruway:			
Main line	New York	426	1954—381 miles. 1955—42 miles. 1956—3 miles.
Niagara section	do	21	1956—7 miles. 1959—8 miles. 1960—6 miles.
Erie section	do	70	1957.
Garden State Parkway connection	do	3	1957.
Berkshire section	do	24	1958—18 miles. 1959—6 miles.
New England section	do	15	1958.
Hutchinson River Parkway	do	15	1927.[1]
Saw Mill River Parkway	do	30	1926.[1]
Ohio Turnpike	Ohio	241	1955.
H. E. Bailey Turnpike	Oklahoma	86	1964.
Indian Nation Turnpike (sec. A)	do	41	1966.
Will Rogers Turnpike	do	88	1957.
Turner Turnpike	do	86	1953.
Pennsylvania Turnpike	Pennsylvania	470	1940—160 miles. 1951—167 miles. 1954—33 miles. 1957—110 miles.
Dallas-Fort Worth Turnpike	Texas	29	1955.
Richmond-Petersburg Turnpike	Virginia	34	1956.
West Virginia Turnpike	West Virginia	88	1954.
Total		3,880	

[1] Toll stations established in 1947.

(b) *Age of Facilities*

Total length of all 38 major toll roads included in table I is 3,880 miles. Of this mileage, 271.4 miles, or approximately 6.9 percent, was completed and in operation prior to 1946, and 93.1 percent, or

3,564 miles, was opened to traffic between 1946 and 1965. Some 2,432 miles were completed from 1955 to 1965 inclusive, so that a little over 62 percent of these modern toll highways were built within the last 11 years.

(c) *Description of Facilities*

The 38 major toll roads in the United States are, with few exceptions, high-speed expressways having divided roadways with two or more lanes in each direction and with limited access to and from other highways by grade separated interchanges. In general, the functional design of modern toll roads corresponds to construction standards required (and permitted) on the Federal System of Interstate and Defense Highways, of which many toll roads are a designated part. Design standards on some toll roads built prior to establishment of Interstate standards are not entirely in accord with present Interstate requirements. On the other hand, they also exceed Interstate design standards in many instances.

The function of a modern toll road is to provide safe and economical high speed automotive travel over considerable distances without interruption by cross traffic.

In order to attract traffic at a level sufficient to discharge obligations incurred by the original investment, toll roads must provide and maintain a considerably higher level of service than other alternate routes. They must follow the highest standards of maintenance to provide if at all possible a smooth, dry and safe driving surface, even during periods of adverse weather conditions. They must provide adequate highway patrol and other services to assure a higher level of safety and a free flow of traffic.

In addition, most toll roads provide on-the-road service facilities including restaurants and service stations. Toll roads also provide emergency highway services to motorists with disabled vehicles, a service not normally provided on other public highways.

In 1965, the major toll roads reported that a grand total of 676,782,999 vehicles utilized their facilities, driving a total of 19.28 billion vehicle miles, an increase of 10 percent over 1964.

(d) *Ownership*

All of the 38 major toll roads (table I) are owned and operated either by a State highway department or by toll road authorities or commissions created by State law. The State highway departments owning and operating toll roads include Colorado, Connecticut, Delaware, Florida, and Maryland. The Florida State Turnpike Authority, a separate agency, owns and operates the 265-mile Sunshine State Parkway.

Because they are, by law, State agencies, toll road authorities and commissions are given through enabling legislation certain authority and specific responsibilities within that authority. While the specific provisions of such enabling legislation may vary in detail from one State to another, such enabling acts generally provide that a toll road authority or commission may be established, in some instances outlining its requirements and describing the facility or facilities authorized, their financing, construction, and operation in the public interest.

II. TOLL BRIDGES AND TUNNELS

1. BRIEF HISTORY

Bridges, causeways, and tunnels are being combined under a single category because their functions are basically the same.

Toll bridges came into being for the same reason as toll roads. They became feasible and practical because of the demand for crossing a body of water at a particular point. Ferries powered by horses or oxen had a limited capacity and were adaptable for use only on relatively short crossings. As the demand for better crossings grew, enterprising individuals, and sometimes companies organized for this purpose, began constructing toll bridges under special charters to connect the primitive road system in the early years of our Nation. Thus, the first toll bridges, like toll roads, came into existence as a venture of private enterprise.

In a young, growing country having very limited tax resources, the advantages of private financing, ownership and operation of toll bridges were obvious. Public funds were not available, a crossing was definitely required and the private enterprise approach was the fastest and least painful way of providing a bridge, while at the same time avoiding direct responsibility for its operation and maintenance.

Unlike early toll roads, construction and operation of toll bridges flourished, and the trend toward publicly owned and operated toll bridges did not become general until about 1930.

Original statutory and policy opposition of the Federal Government to the imposition of tolls on all highway facilities was softened as to bridges in 1927. The "Oldfield Act" of that year provided that Federal-aid highway funds could be extended to the construction of any toll bridge and approaches thereto under certain conditions. These were: (1) that the bridge be owned and operated by States or their political subdivisions, and (2) that "all tolls received from the operation thereof, less the actual cost of operation and maintenance, are applied to the repayment to the State or States, or political subdivision or subdivisions thereof, of its or their part of the cost of construction of such bridge and, upon the further condition that when the amount (so contributed) shall have been repaid from the tolls, the collection of tolls for the use of such bridge shall thereafter cease, and the same shall be maintained and operated as a free bridge."

The statute was further amended in 1956 to include tunnels as well as bridges and has remained part of Federal law. Federal-aid funds were used in the construction of a number of bridges and/or approaches under the Oldfield Act, but several of these have since become toll free and only eight were in operation as toll facilities by the end of 1964.

The trends toward governmental ownership and the creation of special authorities and commissions to finance and operate toll bridges were revolutionary. Many of the original structures built by bridge companies had, by the late 1920's, become old or obsolete so that an entirely new and larger facility was required. In some instances, the original bridge owners could finance a new structure or rebuild the existing structure to new specifications. Others were not in a position to do so. The result was that a privately owned bridge was sometimes purchased by a municipality, a county or a State, which in turn operated it or created an authority or commission to provide, operate,

and maintain a new structure. In some cases, financial failure of the original venture made it necessary for the owners to sell the structure. In others, disasters, including serious floods or fires, rendered the original structure useless and unsafe, which in turn led to a transfer of ownership. The trend toward public ownership and operation of toll bridges has continued to the present time.

Vehicular toll tunnels in comparison to bridges are a rather recent development made possible by tremendous advancements in technology. Their functions and services are essentially the same as toll bridges.

2. EXISTING CAPITAL PLANT

As of early 1965, there were 193 toll bridges and causeways located entirely within the United States, according to information compiled by the International Bridge, Tunnel & Turnpike Association. There are also 10 toll bridges crossing the border from the United States to Canada and 11 between the United States and Mexico. Table II lists these bridges by State, indicating that a number are bistate bridges.

It is difficult to arrive at figures reflecting true or total investment in toll bridges in the United States. Tabulated below is a listing of bridges by number constructed in each 10-year period and a corresponding reported investment cost.

TABLE II

United States:	*Number of bridges*
Alabama	1
Arizona	1
California	8
Colorado	1
Connecticut	8
Delaware-New Jersey	1
Florida	18
Georgia-Florida	1
Georgia-South Carolina	1
Illinois	2
Illinois-Indiana	3
Illinois-Iowa	9
Illinois-Kentucky	1
Illinois-Missouri	7
Indiana-Kentucky	1
Iowa-Nebraska	5
Iowa-Wisconsin	1
Kansas-Missouri	2
Kentucky	1
Kentucky-Ohio	3
Kentucky-West Virginia	3
Louisiana	3
Maine	4
Maine-New Hampshire	1
Maryland	5
Maryland-Virginia	1
Maryland-West Virginia	1
Massachusetts	1
Michigan	2
Minnesota-Wisconsin	2
Mississippi	2
Missouri	4
Missouri-Iowa	1
Missouri-Nebraska	2
Montana	1
New Hampshire	1
New Hampshire-Vermont	1
New Jersey	8
New Jersey-Pennsylvania	10
New Jersey-New York	4
New York	19
New York-Pennsylvania	1
New York-Vermont	2
Ohio-West Virginia	4
Oregon-Washington	7
Pennsylvania	1
Rhode Island	2
South Carolina	1
Texas	2
Virginia	10
Washington	10
West Virginia	1
West Virginia-Virginia	1
Total	193
International crossings:	
Michigan-Canada	2
Minnesota-Canada	1
New York-Canada	7
Texas-Mexico	11
Total	21
Grand total	214

TABLE III

Year	Number of bridges	Investment
Prior to 1899	8	$17,297,620
1900-09	5	1,254,840
1910-19	9	34,772,250
1920-29	43	154,185,850
1930-39	34	431,261,230
1940-49	23	64,208,300
1950-59	82	1,346,816,450
1960-65	14	644,693,960
Total	218	2,694,490,500

Improvements to toll bridges over this period amounted to $254,355,000 making the total investment in bridges $2,948,845,500. Four bridges of the 218 recorded are now toll free.

III. TUNNELS

1. HISTORY

Exclusive of those tunnels which are a part of combined bridge-tunnel or road-tunnel projects, there are now 10 vehicular tunnel projects, including 1 between the United States and Canada. The first of these was the Holland Tunnel constructed by the Port of New York Authority between New York and New Jersey and opened in 1927 at an original reported cost of $50,813,600.

From 1930 to 1939, a total of $224,800,000 was utilized to build three major tunnels: the Sumner Tunnel in Boston, the Detroit-Windsor Tunnel between Michigan and Canada and the Lincoln Tunnel between New York and New Jersey; plus $8,200,000 for tunnel improvements. From 1940 to 1949 the Bankhead Tunnel in Alabama and the Queens Mid-town Tunnel in New York were completed at a cost of $69,910,000. This amount plus an expenditure of $8,200,000 for tunnel improvements brought the investment for this period to $78,110,000. A total of $319,046,000 was invested in the construction of new tunnels and the improvement of two existing tunnels between 1950 and 1959. The new tunnels constructed in these years include the Baltimore Harbor Tunnel, the Brooklyn Battery Tunnel in New York and the Callahan Tunnel in Boston. The Mid-town Tunnel in Hampton, Va. was constructed at a cost of $41,700,000 in 1960.

The total original cost of these 10 tunnels is reported as $703,769,600. Improvements made over the years are given as $11,748,000, making the total tunnel investment $715,517,600.

Approximately 99 bridges and causeways are less than 20 years old, 20 are over 20 years old and 34 are over 30 years old. Bridges 40 or more years old total 65.

All of the 10 tunnel projects are less than 40 years old. Two are 5 years old, one is 10 years old, and one 15 years old. Five were completed a little over 20 years ago. The Holland Tunnel was completed in 1927.

2. DESCRIPTION OF FACILITIES

Toll bridges in the United States can truthfully be described as encompassing every size and description. They vary from the Oldtown Bridge between Maryland and West Virginia built at a cost of a little over $12,000 to such giants as the George Washington and Verrazano-Narrows Bridge in New York, the Golden Gate Bridge in San Francisco, and the Chesapeake Bay Bridge-Tunnel project between Cape Charles and Norfolk, Va.

From a standpoint of construction and design, the largest bridges are suspension type structures, others are steel truss, some are steel or concrete trestle bridges, some are bascule bridges and others are steel and concrete arch structures and some are various combinations of types. In traffic-carrying capacity, they vary from a simple 2-lane bridge to the 14 lanes of traffic accommodated by the George Washington Bridge on 2 levels.

The basic function of a toll bridge or tunnel is, of course, to provide an expeditious, safe, and direct crossing of a body of water or other geographical barrier along a route desired by vehicular traffic.

In order to perform this function, the bridge or tunnel must be constructed at a point where established traffic desires can be served and to such design standards that it will assure good direct traffic service so that it may discharge the financial obligation incurred in its construction plus cost of operation and maintenance.

In 1965, the International Bridge, Tunnel, & Turnpike Association received reports showing that a grand total of 676,467,519 vehicles utilized 90 bridge and tunnel facilities during the year.

Ownership

Exclusive of the few bridges and one tunnel in private ownership toll bridges and tunnels in the United States are owned and operated either by a special public service authority or by a State or local government. In some cases, these authorities or commissions were created by States, others by cities and/or counties under State enabling legislation. In a number of cases, such authorities are bistate in nature and were organized under enabling legislation of two States with concurring legislation adopted by Congress. Among these are the Port of New York Authority (New York and New Jersey), the Delaware River & Bay Authority (Delaware and New Jersey), the Delaware River Port Authority (Pennsylvania and New Jersey). In cases where bridges or tunnels cross international boundaries, special approval is required not only from the State or Province in which they are to be located, but by international compact or other agreement between cooperating countries to authorize the construction and operation of the facility.

B. Operating Costs and User Charges

1. OPERATING COSTS

For purposes of this report, operating costs are considered to include administrative costs, operating expenses, maintenance costs and overhead costs which are basic and essential to the operation of toll facilities.

Operating costs on toll bridges and tunnels vary widely in relation to the physical size of the facility, the amount and kind of traffic handled, the age of the facility and its geographical location. In brief, a short two-lane bridge with traffic volumes of perhaps 4,000 to 5,000 vehicles per day will have small operating expenses in comparison to a six-lane bridge handling 50,000 vehicles a day. The costs of personnel and maintenance in a large metropolitan area will normally be higher than those in a comparatively small city. Considering these and many other local and individual factors, there appears to be no common denominator which can be applied to develop an average cost for the operation of toll facilities. Although detailed reports of operating costs on all toll bridges are not available, it is estimated that these total costs as defined above for toll bridges and tunnels in the United States exceed $75 million annually.

Operating costs for toll roads are somewhat different, but they again vary widely for the same general reasons as indicated for bridges. Generally speaking, total operating costs of toll roads, including administration, maintenance and overhead expenses essential to the operation, vary from $20,000 per mile to over $40,000 per mile annually. A toll road carrying high volumes of mixed traffic will have greater operating expenses than another of equal length having a much lower volume of traffic. A toll road in a northern climate will have comparatively higher operating costs than one in a warm climate. Similarly, a toll road traversing a heavily populated area will have higher operating costs than one passing through a rural area, and a toll road 15 years old will have higher annual maintenance costs than one built in 1964.

Taking these and other factors into consideration, it is estimated that the total cost of operation, including administration, maintenance, and necessary overhead expense, exceeds $150 million annually for the 38 major toll roads in the United States.

2. USER CHARGES

All toll facilities, regardless of size or location, provide funds for their operations and debt service through placing a user charge on all vehicles using their facility. The "user-pay" principle is the basis for their existence.

On toll bridges, the user fees or tolls vary from a 5-cent toll for passenger vehicles to $4.95. A few facilities also make a small charge per passenger and some for pedestrians.

Truck user fees are, of course, higher than passenger vehicles. These are usually divided into classes based generally upon size and weight. The classifications adopted vary from one facility to another.

Passenger car toll rates on toll roads can best be described as ranging from 1 cent per mile to about 3.5 cent per mile. Again, these rates reflect differences in the original cost of construction, the amount of passenger car traffic in relation to commercial trucks and buses, debt retirement and interest costs, and costs of operation and maintenance. Toll rates for commercial vehicles are higher than those of passenger vehicles on toll roads. As in the case of bridges and tunnels, commercial vehicles are generally classified by size and weight and a toll rate is established for each class.

A number of facilities have adopted commuter discount rates for passenger vehicles and volume discount rates for commercial vehicles.

Some toll agencies also have charge accounts for trucks and buses. These special rates and regulations vary considerably from one agency to another.

Basically, the toll structure (schedule of toll rates by class of vehicle) is designed to produce sufficient revenue from user fees to provide for the operation and maintenance costs of the project and for interest on and retirement of the debt incurred in its financing. This involves adopting a rate schedule that is fair and equitable for each class of vehicle and one which will attract sufficient traffic to meet all financial obligations incurred.

Since toll schedules are calculated and adopted well in advance of project completion, actual experience may in some instances indicate that the rates are too low or too high. As a result, there have been instances where toll schedules have been adjusted upward to meet fiscal requirements or downward in the interest of the public service.

C. Trend of Capital Outlays

1. ANNUAL TRENDS

The trend of reported capital outlays for toll facilities between 1946 and 1965 is tabulated on an average annual basis below. An annual average is utilized primarily because expenditures for all projects do not lend themselves to annual allocations due to size of the project, its method of financing, improvements added, and other reasons.

Type of facility	Capital investment, 1946–65	Annual average, 1946–65
Tolls roads	$5,389,035,000	$269,451,750
Toll bridges	2,002,170,400	100,108,000
Toll tunnels	361,784,000	18,089,000
Total	7,752,989,400	387,648,750

As shown above, the average annual capital outlay for toll facilities between 1946 and 1965 is reported at over $387 million a year.

Investment by levels of government

Except by visiting each toll facility or authority and making a detailed investigation, it would be impossible to determine the role of the various levels of government in financing toll facilities over a period of 50 years. Many of them were financed in various ways and sometimes by more than one agency. In general, it may be said that over 90 percent of all toll facilities presently in existence were financed through an authority or commission created by State and local governments for this purpose and in certain instances via enabling legislation by Congress.

2. SOURCES OF FINANCING

Toll facilities are financed by the sale of bonds which fall into three general classifications. *Revenue bonds* are those supported only by the income from the toll project. *Limited obligation bonds* are issues secured wholly or partly from the proceeds of highway use taxes, such as the State gasoline tax, but which do not carry the further guar-

antee of the State's credit. *General obligation bonds* are backed by the full faith and credit of State, county, or municipality.

Revenue bonds usually carry a higher interest rate than either limited obligation or general obligation bonds because of the greater risk involved. In some cases, a combination of two or more of these financing methods is employed, notably in the financing of the New York Thruway, which is worthy of further comment.

The thruway is a 559-mile toll road running through the principal traffic corridors of New York State, the main trunk connecting New York City with Buffalo. It was begun as a free facility shortly after World War II, but it soon became obvious that it could not be completed for a generation or more from tax resources.

It was decided to make it a toll road and the New York State Thruway Authority was created to finance, build, and operate the facility. It obtained its first financing from short-term notes, comprising a $10 million loan in 1950 and a $60 million loan in 1952. In 1951, the New York electorate authorized the State guarantee of $500 million of thruway authority bonds, which was considered sufficient to cover the cost of the thruway as then contemplated. In 1953 the short-term notes were retired from proceeds of the authority's first issue of State guaranteed bonds.

It became apparent, meanwhile, that rising construction costs and additions to the thruway system would result in a final cost greatly in excess of the authorized $500 million of State guaranteed bonds. In 1954 the legislature granted the authority power to issue revenue bonds to finance completion of the project. The revenue bonds have first claim on thruway income, even over the State guaranteed issues, and this situation held the interest costs on the revenue bonds to a low level.

The Garden State Parkway in New Jersey also was financed largely by State guaranteed bonds. But these cases are the exceptions, rather than the rule. Another unusual feature in both cases is the fact that there are "free" sections on both toll roads where Federal aid was made available. Bond issues, of course, have financed many nontoll highway projects and are continuing to do so, but these are outside the scope of this report.

Total investment in toll facilities

It is difficult to arrive at figures reflecting the value of all toll facilities presently operating in the United States. A survey of the membership of the International Bridge, Tunnel & Turnpike Association, and data gathered from many different sources indicate that the original cost and improvements made for all toll facilities in existence are as tabulated below:

	Investment to date
38 toll roads	$5, 248, 203, 000
Toll bridges	2, 948, 845, 500
Toll tunnels	715, 517, 600
Total	8, 912, 566, 100

If the investment of $290,559,000 for the 20 special purpose toll roads is included, the original investment in all toll facilities is calculated as a little over $9.2 billion. This total does not reflect their present or "replacement" value.

New toll facilities now under construction are estimated to cost $627 million, including $192 million for toll roads and $435 million for bridges. New tunnels are planned but are not yet under construction.

D. The Outlook: 1966–1975

Forecasting activity in the provision of new and expanded toll facilities over the next decade involves the cloudiest of crystal balls. Aside from the ever-present possibility of a major war or depression, predictions must be hedged by—

1. Uncertainties as to the amount of Federal and State financing available during this period.
2. Conditions in the bond market.
3. The impact of other forms of transportation on motor vehicle highway travel.

Even assuming that pending legislation is enacted to provide the necessary financing to complete the National System of Interstate and Defense Highways on schedule in 1972, there is presently no provision for a Federal-aid highway program thereafter. It is generally assumed that there will be one but its size, direction and Federal-State matching ratios are unknown quantities.

At the State level, matching of Federal-aid funds in the required ratios has been a serious problem in some cases and will mount as more of the new interstate and other highways are opened. Under existing law, the States bear the entire cost of maintaining the Federal-aid roads.

Also, under existing law, a State may decide to build a section of the Interstate System as a toll road provided no Federal funds are used Under the dual compulsion of limited budgets and the need for providing a traffic facility faster than the flow of Federal-aid funds would permit, additional States may turn to toll financing of portions of their Interstate or other highways. This was done, for example, by the States of Delaware and Maryland in 1962 to finance Interstate 95 through those States.

Conditions in the bond market naturally affect the timing of proposed borrowing. Early in 1966, the New Jersey Turnpike Authority sought to market a $440 million bond issue, but rejected the bid it received as too high.

Another imponderable is the effect on highway travel of other forms of transportation during the next decade. Highway needs may or may not be diminished by fast rail service, increased use of jet planes for short hauls, and more exotic forms of transportation such as underground tubes, hydrofoils and air-jet vehicles.

Nevertheless, a survey of the member facilities of the International Bridge, Tunnel & Turnpike Association shows this picture for projected new projects and capital improvements between 1966 and 1975.

	New facilities	Improvements
Toll roads	$540,000,000	$602,000,000
Toll bridges	728,000,000	367,000,000
Toll tunnels	45,000,000	200,000
Total	1,313,000,000	969,200,000
Total	2,282,200,000	

This includes only those projects planned to a point where general cost estimates are available and is limited only to members of the IBTTA who replied to the survey questionnaire. There may be other projects that are not now planned which may become a reality. Nor does this figure take into account the fact that new toll authorities and commissions are being created and that other toll projects are undoubtedly being planned on which specific information is not available. Such projects may well increase the total of $2.282 billion.

More than 2,200 miles of new toll facilities including toll roads and 47 bridges are presently under construction or planned, according to the Special Committee on the Federal-aid Highway Program, House Committee on Public Works. The cost of only a portion of these is included in the $1,313 million above because firm cost estimates are not yet available for the remainder. It is believed, however, that if all of these projects move on to become a reality, total expenditures for new projects, and for extensions to and improvements of existing projects, may approximate $5 billion between 1966 and 1975. This general estimate, assumes of course, that a continuing and uninterrupted high level of economic activity will be maintained throughout the period and that the present provisions of Federal highway law will not be changed in a way which will have an adverse effect on existing or projected toll facilities.

CHAPTER 12

Offstreet Parking Facilities *

A. NATURE AND COMPOSITION

1. DESCRIPTION OF FACILITIES

Offstreet parking is a service that is provided by both the private and public sectors of our urban communities. In the public area it is planned, financed and operated by a variety of municipal agencies. These are city departments, parking agencies, parking boards and autonomous parking authorities. In all cases there is legislative action which usually defines the limits these bodies possess. These official groups have a keen interest in assuring that the motoring public is provided with a coordinated system of terminal facilities.

In the post-World War II years the crushing impact of demand for parking space in urban areas, large and small, became apparent to most American cities and as a result many legislative proposals were introduced and enacted into law by the various State legislatures and in city councils throughout the land. Many reasons were behind this governmental movement into a field that had been one primarily of private enterprise. Among these reasons were that private industry could not meet the challenge alone, either due to difficulty in financing parking developments on a broad basis or lack of ability in acquiring properly located sites which would relate to the overall transportation plans of the urban area.

The general physical characteristics of the plant and equipment involved in such installations are the surface parking lot which may be operated by automatic gates, attendants, parking meters or in a variety of other methods. This is the most elementary of the methods for storing the vehicle. Next in the order of complexity would be the open ramp garage, followed by the underground garage which is usually only found in the largest urban areas and almost without exception beneath publicly owned land providing a multipurpose use of the land for a park and vehicle storage area. In both of these types of garages very sophisticated equipment is utilized to maintain complete control of occupancy levels and to provide very rigid financial controls on the operations. In addition there have been limited numbers of mechanical parking garages developed and installed throughout the country. Usually these are found on very high priced land in areas where there is a very high demand for short-term parking with a resultant high turnover. The latest trend in some areas of the country is the

*Prepared by William D. Heath, Executive Director, District of Columbia Motor Vehicle Parking Agency and Secretary of the International Municipal Parking Congress, with minor editing by committee staff.

multipurpose building; that is, an office building with a certain amount of parking provided as an integral part of the building. Quite frequently the reason for the provision of parking integrally is to comply with local zoning ordinances which require the provision of parking based on various scales.

Services Rendered

The parking services rendered by municipalities are in great part confined to the commercial heart of the city, however, there are exceptions to this. In some cases where a parking shortage has occurred in an industrial area the municipality has stepped in to relieve the deficiency. In the case of a manufacturer who may be thinking of moving his plant to an outlying area because of the difficulties his employees have parking, it can be to the economic benefit of the community from a fiscal standpoint for the city to provide the parking facilities rather than to lose the tax revenues from the plant. Other municipalities have found it desirable and necessary to provide offstreet parking in residential areas, an outstanding example of this is a midwestern city which has provided a great many residential parking lots. Another facet of municipal parking is the provision of parking facilities in neighborhood shopping areas. This has generally occurred in the older and larger cities where the neighborhood centers were situated in a strip development along streetcar lines and before the automobile became a part of the American way of life. Other cities which are located in the center of recreational areas have had to establish parking facilities to serve the users of such areas. Examples of this type are found both on our east and west coast where large numbers of persons are attracted by the pleasures that the oceans afford.

A recent study conducted for the Automobile Manufacturers Association disclosed the distribution of central business district parking facilities by population groups, registered vehicles, and area. (Figs. 1–5.)

The durability of parking structures can be equated with any commercial building constructed of reinforced concrete or structural steel. Maintenance of these structures is of limited nature and consists primarily of sealing and waterproofing of floors, painting and striping of stalls. One of the greatest factors of obsolescence found in older garage structures has been the increase in size of the vehicle over a period of years. Many old structures designed for three cars to a bay have had their capacity reduced by one-third because of this factor. Using modern techniques the garage of today is a clear span structure and any change in the size of vehicles will only result in the repainting of stall lines with very minimal loss of space.

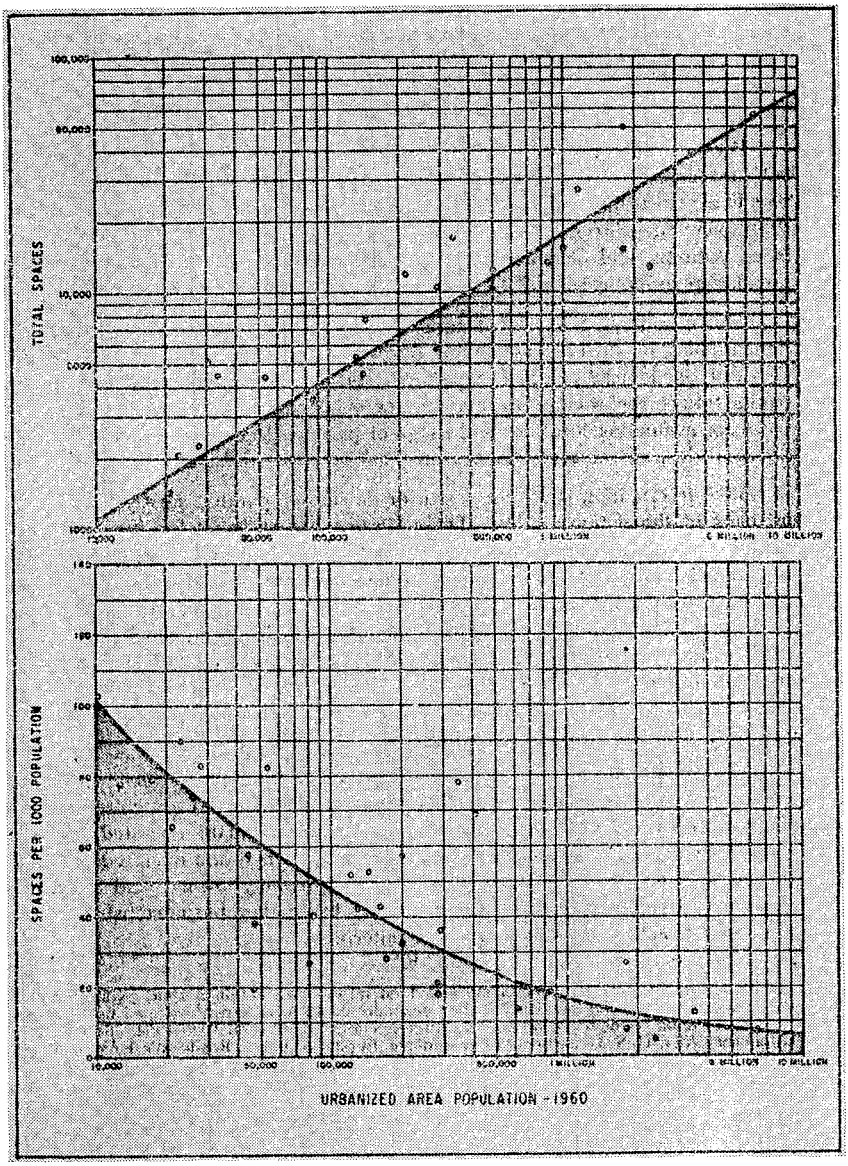


FIGURE 1

CENTRAL BUSINESS DISTRICT PARKING SPACES IN RELATION TO URBANIZED AREA POPULATION

-4-

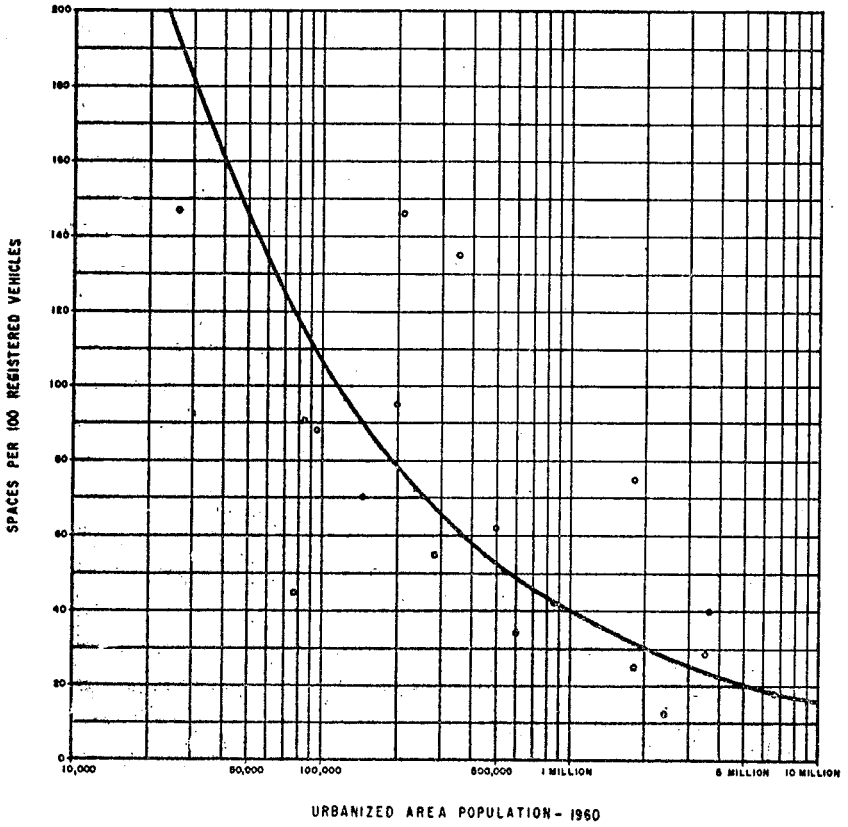


FIGURE 2

CENTRAL BUSINESS DISTRICT PARKING SPACES PER REGISTERED VEHICLE, 1960

The spaces per registered vehicle decline as the urban area increases in population. When urbanized area population approximates 100,000, central business district parking spaces approximate 110 per 1,000 registered vehicles. When the urbanized area reaches one million people, there are approximately 40 spaces per registered vehicle. For Los Angeles (with an urbanized area population of six million) there are only 18 spaces per 1,000 registered vehicles.

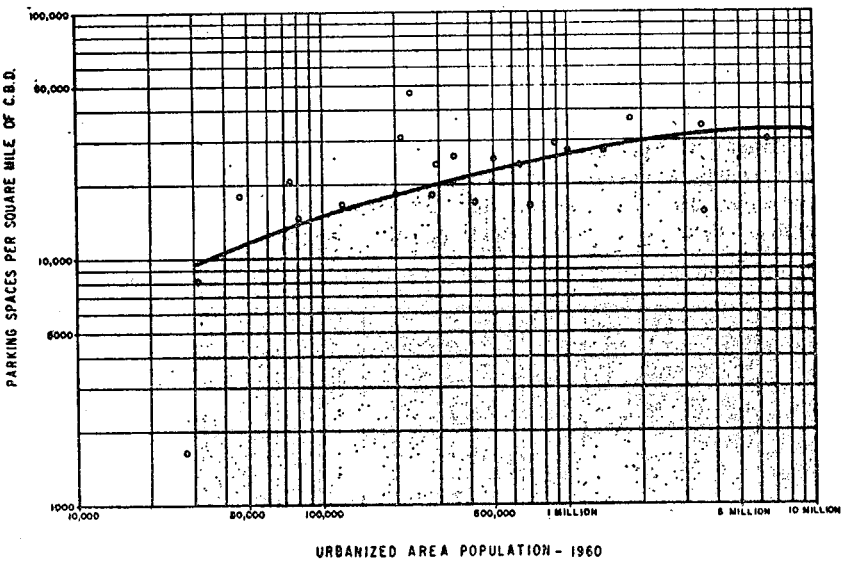


FIGURE 3

PARKING SPACES PER SQUARE MILE OF CENTRAL BUSINESS DISTRICT

On a square-mile basis, the number of downtown spaces increases gradually as urban population rises. Parking spaces per square mile of downtown approximate 15,000 for urban populations of 100,000, and 23,000 for urban populations of 500,000. When urbanized areas approach two million, parking spaces per square mile level off at about 30,000.

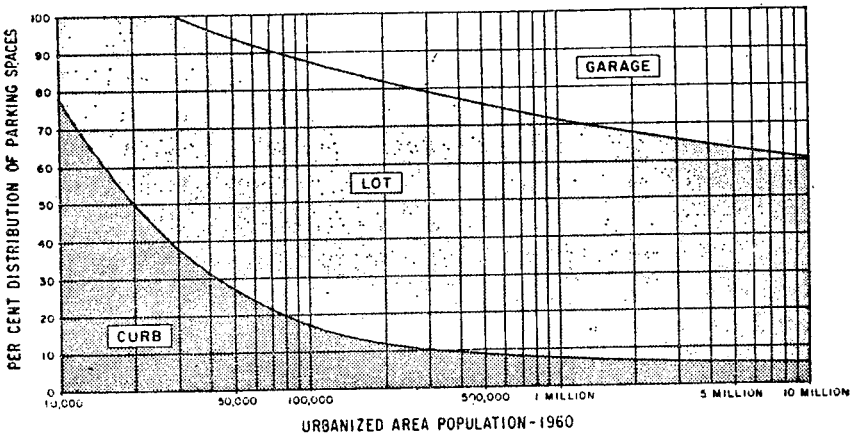


FIGURE 4

DISTRIBUTION OF CENTRAL BUSINESS DISTRICT PARKING SPACES BY TYPE OF FACILITY

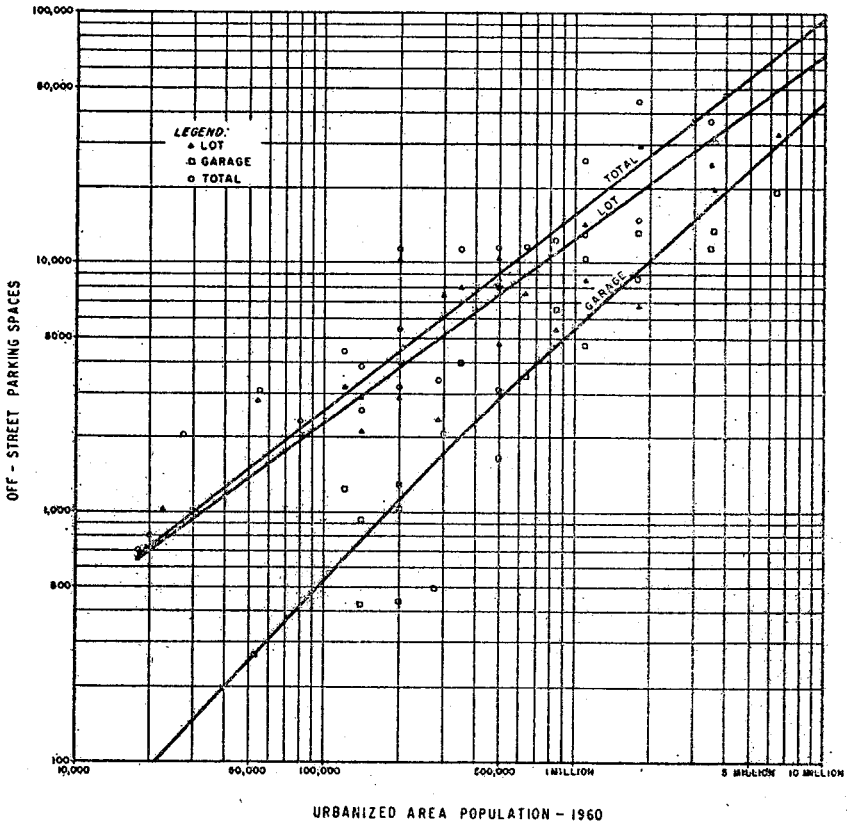


FIGURE 5

OFF-STREET PARKING SPACES
IN RELATION TO URBANIZED AREA POPULATION

As urban areas increase in size, the number of garage spaces increases at a faster rate than parking lot spaces. Central business districts in urbanized areas of 200,000 or less usually have fewer than 1,000 spaces in parking garages. This number increases substantially as urban areas enlarge; there are about 5,500 garage spaces in urban areas of one million in population. The total off-street spaces averaged 2,800 in urbanized areas of 100,000, 16,000 in areas of one million, and about 28,000 in urbanized areas of two million population.

2. EXISTING CAPITAL PLANT

Capital plant in the parking field is presented from two sources:

The 1961 Municipal Yearbook published by the International City Managers' Association reports that for 1960 the following city-owned parking lots and spaces existed:

City-owned parking lots and spaces, 1960

Population group	Number of cities reporting	Total number of cities					
		With parking lots	Charge, all lots	Free, all lots	Some charge, some free	Median number city-owned spaces	Total number city-owned lots
Over 250,000	43	23	17	1	5	914	226
100,000 to 250,000	77	37	25	2	10	800	230
50,000 to 100,000	169	121	80	10	29	609	802
25,000 to 50,000	322	241	111	56	73	414	1,221
10,000 to 25,000	479	353	140	93	117	240	1,382
All cities over 10,000	1,090	775	373	162	234	255	3,861

Census of Business for 1963 published by the U.S. Census Bureau

Region, division, and State	Auto parking					
	Total		Parking lots		Parking structures	
	Establishments (number)	Receipts (in thousands of dollars)	Establishments (number)	Receipts (in thousands of dollars)	Establishments (number)	Receipts (in thousands of dollars)
United States total	11,269	415,605	9,141	225,767	2,128	189,818
Regions:						
The Northeastern States	3,365	(D)	2,382	64,068	983	(D)
The North Central States	2,849	104,011	2,421	58,728	428	45,283
The South	2,965	86,269	2,540	(D)	425	(D)
The West	2,090	(D)	1,798	(D)	292	(D)
The Northeastern States:						
New England	538	(D)	452	12,046	86	(D)
Middle Atlantic	2,827	127,782	1,930	52,022	897	75,760
The North Central States:						
East North Central	2,100	77,365	1,790	43,187	310	34,178
West North Central	749	26,646	631	15,541	118	11,105
The South:						
South Atlantic	1,312	43,901	1,105	28,055	207	15,846
East South Central	554	12,253	492	8,694	62	3,559
West South Central	1,099	30,115	943	(D)	156	(D)
The West:						
Mountain	389	(D)	354	(D)	35	2,851
Pacific	1,701	65,595	1,444	(D)	257	(D)
New England:						
Maine	26	643	21	409	5	234
New Hampshire	6	76	6	76	0	0
Vermont	1	(D)	0	0	1	(D)
Massachusetts	270	13,075	220	6,576	50	6,499
Rhode Island	92	2,493	83	2,011	9	482
Connecticut	143	4,403	122	2,974	21	1,429
Middle Atlantic:						
New York	1,664	91,187	952	30,258	712	60,929
New Jersey	350	8,350	312	6,745	38	1,605
Pennsylvania	813	28,245	666	15,019	147	13,226
East North Central:						
Ohio	678	23,817	589	14,877	89	8,940
Indiana	250	7,368	232	5,365	18	2,003
Illinois	505	27,987	360	10,617	145	17,370
Michigan	561	14,784	521	10,126	40	4,658
Wisconsin	106	3,409	88	2,202	18	1,207

See footnote at end of table.

Census of Business for 1963 published by the U.S. Census Bureau—Continued

Region, division, and State	Auto parking					
	Total		Parking lots		Parking structures	
	Establishments (number)	Receipts (in thousands of dollars)	Establishments (number)	Receipts (in thousands of dollars)	Establishments (number)	Receipts (in thousands of dollars)
West North Central:						
Minnesota	176	8,893	143	4,766	33	4,127
Iowa	94	2,136	83	1,314	11	822
Missouri	331	11,179	287	7,244	44	3,935
North Dakota	22	426	20	(D)	2	(D)
South Dakota	9	111	8	(D)	1	(D)
Nebraska	68	2,735	51	1,214	17	1,521
Kansas	49	1,166	39	613	10	553
South Atlantic:						
Delaware	26	828	23	(D)	3	(D)
Maryland	184	5,613	146	2,860	38	2,753
District of Columbia	286	13,848	237	(D)	49	(D)
Virginia	90	2,526	79	1,588	11	938
West Virginia	72	1,846	64	1,468	8	378
North Carolina	140	2,880	129	2,301	11	579
South Carolina	42	548	40	(D)	2	(D)
Georgia	207	7,764	153	4,096	54	3,668
Florida	265	8,048	234	6,064	31	1,984
East South Central:						
Kentucky	133	3,213	122	2,574	11	639
Tennessee	237	5,921	200	3,757	37	2,164
Alabama	152	2,694	142	2,087	10	607
Mississippi	32	425	28	276	4	149
West South Central:						
Arkansas	65	1,338	51	(D)	14	(D)
Louisiana	164	5,325	135	2,669	29	2,656
Oklahoma	158	3,494	139	2,092	19	1,402
Texas	712	19,956	618	12,478	94	7,480
Mountain:						
Montana	5	(D)	3	14	2	(D)
Idaho	8	105	8	105	0	0
Wyoming	7	234	7	234	0	0
Colorado	180	5,680	161	4,118	19	1,562
New Mexico	17	213	17	213	0	0
Arizona	76	1,989	69	1,636	7	353
Utah	59	1,498	54	1,055	5	443
Nevada	37	1,406	35	(D)	2	(D)
Pacific:						
Washington	203	9,203	151	4,069	52	5,134
Oregon	93	5,124	77	4,062	16	1,062
California	1,385	49,764	1,197	30,249	188	19,515
Alaska	0	0	0	0	0	0
Hawaii	20	1,504	19	(D)	1	(D)

(D)—Withheld to avoid disclosure.

There is no definitive material available on the age of such facilities but from experience we can be sure that the greater part of them have been constructed since the post World War II years.

B. Costs and User Charges

1. CONSTRUCTION AND OPERATION COSTS

For the open parking lot, based on a per parking stall basis, 1965 construction costs range from a low of $200 per space to a high of $1,300 per car space with an average of $719 per car space. Of necessity all of the construction cost estimates in this section must exclude land costs because of the great variance that would exist between such costs in the central business district of a large urban area and such costs in a smaller urban area. While there would be some difference in construction costs for like areas it is believed that these are not significant and no weight is placed on such differences.

For the open deck garage structure construction costs range from a low of $1,700 per car space to a high of $3,582 per car space with an average of $2,270 per car space. Here again a great variation can exist in the price range per car space. This can be attributed to architectural treatment of the structure, the amount of sophisticated electronic equipment for control purposes and quality of installations for customer convenience. The most costly form of construction is the underground parking garage. There is a saving grace, however, in that without exception such facilities are constructed in public land, usually a park, and there is no cost of land attributed to the facility. Upon completion of the parking facility the park on the surface is restored and in most cases to a higher degree than existed before the construction.

Examples of this type of construction are found in the larger cities such as: Pittsburgh, Chicago, San Francisco, Los Angeles, Detroit, Kansas City, Philadelphia, and many others. Construction costs for this type of parking facility range from a low of $3,100 per car space to a high of $6,500 per car space with an average of $4,250 per car space. There will not be a great deal of difference in these construction costs for different size facilities as the size of a parking facility is based on the parking demand that is forecast for the area. Of necessity there must be a minimum size of a facility otherwise the ramp and aisle areas would make it uneconomic. The usual limiting factor for this type of facility, other than parking demand, is the street or highway capacity to serve it properly.

Annual maintenance costs of the surface parking lot vary greatly dependent upon whether it is an attendant facility, metered facility, or operated by means of automatic parking gates that are actuated by the insertion of a coin or card. The geographical location of the facility also has a great bearing on such costs. In our northern cities snow removal is a large item that does not occur in the warmer climes. In one of the major cities their maintenance costs for attendant parking lots were $9.10 per car space, for metered lots $30.75 per car space and for gate-operated facilities they averaged $11.20 per car space. It should be noted, however, that their operating costs were in a direct inverse ratio. Reported maintenance costs for surface parking lots were from a low of $3.14 per car space to a high of $51.76 per car space. The $3.14 cost came from a southern city where they have no snowfall and the $51.76 cost came from a northern city that experiences heavy snowfall. Excluding these highs and lows the average maintenance cost for surface parking lots averaged $21.18 per car space. For the open deck parking garage maintenance costs per car space go from a low of $5.73 per car space to a high of $22.04 per car space for an average cost of $10.03 per car space. Variations in reported data in this item occur because some cities include certain items as operating expense while others call it a maintenance item. The cost of maintenance per car space for underground garages ranges from $6.19 per car space to $15 per car space.

Annual operating costs for parking facilities are subject to widespread differences. As an example a metered facility has a low labor cost, a self-park facility has moderate labor costs while an attendant park facility has high labor costs. Also the size of the facility has a very great bearing on the operating cost per unit. Operation costs

of metered lots range from a low of $11.70 per space to a high of $32.26 per space with an average cost of $17.90 per space. Lots operated by gates frequently require the services of a cashier and the average annual operating cost of this type of facility is $17 per car space. Lots which are operated as attendant park facilities naturally have the highest operating costs. The lowest cost reported for this type of operation was $54.65 per car space while the highest cost was $192.30 per car space with an average of $82.32 per car space.

2. USER CHARGES

(*a*) Parking fees, lease payments, rentals and assessments are all used in one form or another to pay for all of the services and use of the facilities.

(*b*) A recent survey made by one of the major bond rating services of parking revenue bonds disclosed the following:

(1) The survey covered 52 rated bond issues for 39 cities (45 bond issues) and 7 single project agencies.

(2) As of November 1, 1965, 51 of the 52 issues totaled $195,384,000 in outstanding bonds, one issue unknown.

(3) About 70 percent of the 45 city bond issues with about 80 percent of the bonds were for midwestern and eastern cities.

(4) Pennsylvania had the largest State total with $40,281,000 outstanding and Chicago led the cities with $30,474,000 outstanding.

(5) Twenty of the forty-five city bond issues originated in cities of less than 100,000 population.

(6) Debt service coverage for the 52 bond issues ranged from a low of 0.62 to a high of 5.17. City bond issues average 1.62 and single project bond issues averaged 1.68. The overall average for the group was 1.63.

(7) About 70 percent of the 52 bond issues are rated BB or BBB. These issues averaged 1.41 in debt service coverage. The 17 issues rated A averaged 2.33 in debt service coverage.

(8) Only 4 of the 52 issues showed a debt service coverage of less than 1.

(*c*) The extent to which municipal parking facilities are paid for from general obligation borrowings is impossible to estimate. In many localities onstreet parking revenues and offstreet parking revenues are placed into general funds and expenditures for this type of facility are made from the general fund.

C. Trend of Capital Outlays

The 1963 Census of Business reported that there were 9,141 privately owned parking lots in the United States. The latest data for municipal parking lots in cities over 10,000 population was for the year 1960 and at that time there were 3,861 city owned parking lots. It is estimated that from 1960 to 1963 there were 639 municipally owned parking lots established for a total of 4,500 facilities. Combined with the 9,141 privately owned lots this gives a grand total of 13,641 parking lots in operation at the end of 1963. The municipal operations contain 476,858 offstreet spaces and based on 1965 construction

cost data of $719 per car space represent an investment of almost $345 million (excluding cost of land). This does not take into account the amount invested in the 9,141 privately owned parking lot facilities or the larger amount invested in the 2,128 privately owned parking structures and the unknown number of municipally owned parking structures. Assuming that the privately owned lots are on an average similar in size and construction characteristics to the municipally owned lots we arrive at a capital investment of approximately $700 million in parking lots (excluding land) based on 1965 construction costs. The trend of dollar expenditure for offstreet parking facilities must of necessity increase as our urban population grows and the production of motor vehicles show yearly gains. The Census Bureau Bulletin on City Government Finance in 1963–64 showed that cities expended $192 million during fiscal 1964 for parking facilities while they expended $80 million for the same services in fiscal 1963. This was an increase of 28 percent in 1 year and represented the greatest increase for any one service provided by the cities.

The source of financing municipally owned facilities is listed with the most frequently used method first and the other methods in descending order:

1. General obligation bonds secured by both parking revenues and full faith and credit of the city government.
2. Revenue bonds secured by revenues of the parking system (off- and on-street parking revenues).
3. Revenue bonds secured only by the earnings of the offstreet facilities.
4. Combination of revenue and general obligation bonds.
5. General obligation bonds only.
6. Capital reserve funds.
7. Private capital and other methods.

D. Needs and Prospective Capital Outlays

As noted in the preceding section outlays for municipal parking facilities increased 28 percent from 1963 to 1964 for a total expenditure of $102 million. With the ever-increasing numbers of motor vehicles on our streets and highways and the increasing urbanization of America it would appear as though a 15-percent increase per year for the years 1966 through 1975 would be ultraconservative. This will require capital expenditures for municipally owned parking facilities of $2.4 billion during this decade. While at the present time about one-half of the municipally owned parking spaces are in cities below the 50,000 population level it is believed that because of the increase of population in urban areas that approximately 80 percent of this expenditure will occur in cities with populations of 50,000 or more. It is further believed that the municipally owned facilities account for about 30 percent of the total supply of parking; so on that basis the private sector will require about $5.5 billion for construction of offstreet parking facilities. It is estimated that this expenditure would be made exclusively in cities with a population of over 50,000. This will give an estimated total expenditure of $7.9 billion for the decade 1966 through 1975.

The municipal capital outlays will be made almost exclusively by cities, counties, towns, public authorities, and other local public bodies while the expenditures by the private sector will be made by proprietary or profitmaking organizations.

The expected source of funds for the municipal facilities will be the borrowing in the tax-exempt municipal bond market and appropriations from parking revenues. It is not feasible to give a percentage distribution to each method because of the variety of methods used in municipal budget processes. The source of funds for the privately developed facilities will be exclusively capital flotations in other security markets.

As parking facilities should be self-amortizing, whether municipal or private, there should be no gap between revenues and expenditures. If such a gap is projected there would be recourse to either of two actions. Eliminate the project or increase the fee schedule to make it a self-supporting project. If neither of these actions are practical there is a third course of action for a municipality. It can create an assessment benefit district within the area of influence of a project and assess the property owners who would benefit from the parking facility.

CHAPTER 13

Urban Mass Transit Facilities*

A. NATURE OF URBAN MASS TRANSPORTATION FACILITIES

1. DESCRIPTION OF FACILITIES

As U.S. cities have grown in size and number, urban mass transportation facilities have not grown with them. Unlike other public facilities such as water and sewage systems which lagged behind population growth and increasing concentration of population in urban centers, mass transportation facilities actually decreased in the years following World War II. This was due to several causes, the most important being a great increase in the number and use of private automobiles, coupled with a decline in mass transit service and an increase in its fares.

Urban mass transportation is defined in this chapter as the movement of people within urban areas by large-capacity vehicles operating as common carriers. Mass transportation facilities, therefore, consist of bus, trolley coach, rapid transit, and surface or elevated electric railway systems. Railway commuter service, although a vital part of urban mass transportation, especially in the larger metropolitan centers, is not included in this analysis because of the difficulty in separating it from the railroads' long-distance, intercity service.

Since urban areas vary so widely and there is no consensus on the ideal transportation system or the correct level of service, general standards of performance for mass transportation systems have not been set. The situation is not analyzed by reference to standards of performance but rather in terms of an urban transportation problem. In the 1966 edition of his book *The Metropolitan Transportation Problem*, Wilfred Owens of the Brookings Institution states:

> Every metropolitan area in the United States is confronted by a transportation problem that seems destined to become more aggravated in the years ahead. Growth of population and expansion of the urban area, combined with rising national product and higher incomes, are continually increasing the volume of passenger and freight movement. At the same time, shifts from rail to road and from public to private transportation have added tremendous burdens to highway and street facilities. They have created what appear to be insuperable terminal and parking problems. Continuing economic growth and the certainty of further transport innovation threaten to widen the gap between present systems of transportation and satisfactory standards of service.
>
> Manifestations of the transportation problem in urban areas include the mass movement between work and home and the cost that it represents in money, time, and wasted energy. The transit industry is experiencing rising costs and financial difficulties, while the rider is the victim of antiquated equipment and poor service * * *.

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*By Marge Schier, Urban Transportation Administration, U.S. Department of Housing and Urban Development, utilizing data furnished by the American Transit Association, with minor editing by committee staff.

Half a century of neglect has meant a long-term deterioration of transit service and failure to keep pace with technological change. Rising costs and declining patronage have led to a succession of fare increases and further reductions in service. In many cases, it has been impossible to set aside necessary allowances for depreciation of equipment, and the industry as a whole has been unable to attract sufficient capital to renew, modernize, or extend its services for the nearly eight billion riders per year who depend on public carriers.

2. EXISTING CAPITAL PLANT

(a) *Mass Transit Facilities and Their Distribution by State and City*

As of the end of 1964, common carrier intraurban transportation in the United States was provided by approximately 1,152 transit systems. Of these, 1,129 were exclusively motor bus, 14 electric railway, both subway and elevated (including joint trolley coach and/or motor bus operations), and 9 trolley coach and motor bus operations combined. (See table I.) Table II lists the number of transit companies, both privately and publicly owned, operating in each State and the number and type of transit vehicles in use in each State.

Only five cities in the United States now have high-speed rail rapid transit systems. These are New York, Chicago, Philadelphia, Boston, and Cleveland. A new system is under construction in the San Francisco metropolitan area by the San Francisco Bay Area Rapid Transit District and is scheduled for completion in 1969.

Table IV indicates the distribution of transit systems among cities of varying population. It should be noted that rapid transit systems are confined to cities of 500,000 population or above. The smaller cities rely primarily on bus systems for their public transportation.

On December 31, 1964, there were 2,173 miles of surface, subway, and elevated railway track, 986 miles of trolley coach, and 118,300 miles of motor bus routes in intraurban service in the United States. The equipment operating on these routes consisted of 10,624 railway cars, 1,865 trolley coaches, and 49,200 buses.

TABLE I.—*Number of urban transit companies in the United States, 1951–64 (50 States and the District of Columbia)*

Dec. 31—	Electric railways (including joint trolley coach and/or motorbus operations)	Trolley coach and motorbus operations combined	Trolley coach (exclusively)	Motorbus (exclusively)	Grand total
1951	82	23	2	1,535	1,642
1952	75	22	2	1,522	1,621
1953	70	24	2	1,510	1,606
1954	65	25	2	1,496	1,588
1955	61	23	1	1,399	1,484
1956	44	22	0	1,261	1,327
1957	40	20	0	1,265	1,325
1958	35	16	0	1,250	1,301
1959	34	13	0	1,225	1,272
1960	31	12	0	1,208	1,251
1961	[1] 18	12	0	1,217	1,247
1962	17	11	0	1,177	1,205
1963	14	10	0	1,162	1,186
1964	14	9	0	1,129	1,152

[1] Companies with 100 percent freight and/or switching operations eliminated as of Jan. 1, 1961.

Source: American Transit Association.

TABLE II.—*Geographical distribution—Number of transit companies and number of transit vehicles, Dec. 31, 1964*

Division and State	Number of transit companies	Number of transit vehicles				
		Rapid transit cars	Surface streetcars	Trolley coaches	Motor-buses [1]	Total transit vehicles
United States:	1,152	9,064	1,560	1,865	49,200	61,689
New England	107	299	344	60	3,300	4,003
Middle Atlantic	292	7,443	863	160	15,735	24,201
East North Central	208	1,322	122	987	9,870	12,301
West North Central	82	----	52	18	3,640	3,710
South Atlantic	162	----	----	----	6,435	6,435
East South Central	73	----	----	----	1,635	1,635
West South Central	83	----	35	149	2,720	2,904
Mountain	35	----	----	----	720	720
Pacific contiguous States	107	----	144	491	4,920	5,555
Pacific noncontiguous States	3	----	----	----	225	225
New England:						
Maine	12	----	----	----	180	180
New Hampshire	7	----	----	----	115	115
Vermont	5	----	----	----	30	30
Massachusetts	46	299	344	60	2,265	2,968
Rhode Island	10	----	----	----	165	165
Connecticut	27	----	----	----	545	545
Middle Atlantic:						
New York	101	6,947	----	----	7,710	14,657
New Jersey	87	----	30	----	4,150	4,180
Pennsylvania	104	496	833	160	3,875	5,364
East North Central:						
Ohio	66	88	58	370	2,770	3,286
Indiana	36	----	32	----	630	662
Illinois	36	1,234	32	525	3,760	5,551
Michigan	35	----	----	----	1,550	1,550
Wisconsin	35	----	----	92	1,160	1,252
West North Central:						
Minnesota	25	----	----	----	960	960
Iowa	17	----	----	----	410	410
Missouri	11	----	52	18	1,810	1,880
North Dakota	7	----	----	----	20	20
South Dakota	3	----	----	----	65	65
Nebraska	7	----	----	----	210	210
Kansas	12	----	----	----	165	165
South Atlantic:						
Delaware	2	----	----	----	90	90
Maryland	16	----	----	----	930	930
District of Columbia	2	----	----	----	1,340	1,340
Virginia	33	----	----	----	1,245	1,245
West Virginia	22	----	----	----	410	410
North Carolina	34	----	----	----	500	500
South Carolina	7	----	----	----	160	160
Georgia	18	----	----	----	725	725
Florida	28	----	----	----	1,035	1,035
East South Central:						
Kentucky	18	----	----	----	395	395
Tennessee	21	----	----	----	645	645
Alabama	22	----	----	----	485	485
Mississippi	12	----	----	----	110	110
West South Central:						
Arkansas	12	----	----	----	175	175
Louisiana	17	----	35	89	600	724
Oklahoma	10	----	----	----	200	200
Texas	44	----	----	60	1,745	1,805
Mountain:						
Montana	4	----	----	----	70	70
Idaho	5	----	----	----	15	15
Wyoming	1	----	----	----	10	10
Colorado	7	----	----	----	335	335
New Mexico	3	----	----	----	70	70
Arizona	5	----	----	----	15	15
Utah	7	----	----	----	160	160
Nevada	3	----	----	----	45	45
Pacific contiguous States:						
Washington	26	----	----	131	635	766
Oregon	11	----	----	----	260	260
California	70	----	144	360	4,025	4,529
Pacific noncontiguous States:						
Alaska	2	----	----	----	15	15
Hawaii	1	----	----	----	210	210

[1] Partially estimated.

Source: American Transit Association.

TABLE III.—*Electric railway track and total miles of motorbus and trolley coach route of the transit industry in the United States, 1940, 1945 to 1964, inclusive (50 States and the District of Columbia)*

As of Dec. 31—	Total miles of railway track			Trolley coach miles of negative overhead wire	Motorbus miles of route round trip
	Surface	Subway and elevated	Total		
1940	18,367	1,242	19,609	1,943	78,100
1945	16,480	1,222	17,702	2,357	90,700
1946	15,490	1,226	16,716	2,388	91,400
1947	13,750	1,226	14,976	2,733	95,600
1948	11,740	1,224	12,964	2,952	96,800
1949	10,700	1,231	11,931	3,385	96,700
1950	9,590	1,223	10,813	3,545	98,300
1951	8,240	1,217	9,457	3,715	100,000
1952	7,309	1,223	8,532	3,773	99,900
1953	6,126	1,226	7,352	3,700	100,300
1954	5,547	1,218	6,765	3,667	99,300
1955	4,976	1,221	6,197	3,466	100,100
1956	4,495	1,251	5,745	3,326	101,000
1957	3,774	1,245	5,019	3,007	102,700
1958	2,600	1,244	3,844	2,723	104,800
1959	2,200	1,245	3,445	2,491	106,600
1960	1,900	1,243	3,143	2,196	108,700
1961	1,355	1,246	2,601	2,017	111,500
1962	1,312	1,245	2,557	1,849	114,300
1963	990	1,246	2,236	1,119	117,400
1964	918	1,255	2,173	986	118,300

Source: American Transit Association.

TABLE IV.—*Distribution by size of city, number of transit companies, number of transit vehicles (Dec. 31, 1964)*

Population range (cities)	Number of transit companies	Number of transit vehicles				
		Rapid transit cars	Surface street cars	Trolley coaches	Motor-buses [1]	Total transit vehicles
500,000 plus	30	9,064	1,082	1,485	20,700	32,331
100,000 to 499,999	133	----------	37	300	12,400	12,737
50,000 to 99,999	135	----------	56	58	6,100	6,214
49,999 or less	432	----------	95	22	5,000	5,117
Suburban and other	422	----------	290	----------	5,000	5,290
Total	1,152	9,064	1,560	1,865	49,200	61,689

[1] Partially estimated.

Source: American Transit Association.

(b) *Age of Facilities*

The age of transit facilities is directly related to maintenance costs and to the degree to which such facilities are used by the public. Obsolete, uncomfortable vehicles and old, poorly maintained stations contribute to the spiral of decreasing demand and increasing costs which faces so many transit companies. Increasing operating expenses prevent many transit operators from building sufficient depreciation reserves to replace equipment and often require borrowing to purchase new equipment. Lenders and equipment companies, in turn, are either unwilling to extend credit or charge high interest

rates because the financial future of these transit companies is so precarious.

Tables V, VI, and VII present data on the inventory and age of transit vehicles over a period of years. To make this data meaningful in any interpretation of transit capital equipment needs, some measurement of the useful lives of transit vehicles must be attempted. In the case of buses, the useful life varies according to the conditions under which they are operated, to economic factors such as the financial condition of the operator, and to the technology existing at the time they were manufactured. Recent improvements in the field of metallurgy, for example, have increased the useful lifespan. Those buses built immediately after World War II are inferior to those produced today in terms of physical endurance and performance. Keeping these variations in mind, however, the useful life of a bus can be roughly estimated to be from 12 to 15 years.

No estimate need be made for streetcars and trolley coaches since these are being abandoned by most systems in favor of buses.

For rapid transit cars, 35 years has been advanced as a rough measure of useful life. Again it may vary depending upon circumstances, especially upon the financial ability of the system to purchase new cars.

Using these criteria, an analysis of table V reveals that approximately one-third of the transit buses in 1964 were beyond their useful lifespans. Roughly, about 1.2 percent of the buses were from 33 to 24 years old; 32.5 percent from 23 to 14 years; 45.7 percent from 13 to 4 years; and 21.6 percent were under 4 years. It is more difficult to analyze the data on rapid transit cars since 10-year breakdowns are not provided. In 1964, 7.8 percent were more than 64 years old; 30.1 percent from 43 to 24 years; 38 percent from 24 to 4 years; and 24 percent less than 4 years old.

TABLE V.—*Age distribution of transit vehicles (as of Dec. 31, 1964)*

Year built	Number of transit vehicles				
	Rapid transit cars [1]	Surface streetcars	Trolley coaches	Motor-buses [1]	Total transit vehicles
Before 1900	0	0	0	0	0
During 1901–20	711	0	0	0	711
During 1921–40	2,730	1,560	171	610	48,691
During 1941–60	3,451		1,694	38,475	
Since 1961	2,172	0	0	10,115	12,287
Total	9,064	1,560	1,865	49,200	61,689

Further breakdown of motorbuses:

1921–30	0
1931–40	610
1941–50	16,010
1951–60	22,465

[1] Estimated.

Source: American Transit Association.

TABLE VI.—*New passenger equipment delivered to transit companies in the United States, 1940 and 1945 to 1964, inclusive (50 States and the District of Columbia)*

Calendar year	Railway cars			Trolley coaches	Motor-buses	Grand total
	Surface	Subway and elevated	Total			
1940	463	189	652	618	3,994	5,264
1945	332	0	332	186	4,476	4,994
1946	421	0	421	266	6,478	7,165
1947	626	2	628	955	12,079	13,662
1948	478	248	726	1,430	7,009	9,165
1949	273	415	688	680	3,358	4,726
1950	4	199	203	179	2,676	3,058
1951	56	140	196	600	4,552	5,348
1952	19	0	19	224	1,749	1,992
1953	0	0	0	0	2,261	2,261
1954	0	260	260	0	2,225	2,485
1955	0	288	288	43	2,098	2,429
1956	0	376	376	0	2,759	3,135
1957	0	469	469	0	2,021	2,490
1958	0	428	428	0	1,698	2,126
1959	0	210	210	0	1,537	1,747
1960	0	416	416	0	2,806	3,222
1961	0	468	468	0	2,415	2,883
1962	0	406	406	0	2,000	2,406
1963	0	658	658	0	3,200	3,858
1964	0	640	640	0	2,500	3,140

TABLE VII.—*Trends of passenger equipment owned in the United States, 1940 and 1945–64, inclusive (50 States and the District of Columbia)*

As of Dec. 31—	Railway cars			Trolley coaches	Motor-buses	Grand total
	Surface	Subway and elevated	Total			
1940	26,690	11,032	37,722	2,832	35,100	75,654
1945	26,160	10,217	36,377	3,826	49,841	90,044
1946	24,050	9,429	33,479	4,031	52,636	90,146
1947	20,788	9,370	30,158	4,822	57,137	92,117
1948	16,824	9,456	26,280	5,802	58,732	90,814
1949	14,859	9,869	24,728	6,481	57,226	88,435
1950	13,228	9,758	22,986	6,619	57,000	86,605
1951	10,960	9,644	20,604	7,186	57,810	85,600
1952	9,700	9,476	19,176	7,280	56,110	82,566
1953	7,990	9,244	17,234	7,031	54,800	79,065
1954	6,400	9,200	15,600	6,683	54,100	76,383
1955	5,300	9,232	14,532	6,242	52,500	73,274
1956	3,970	9,255	13,225	5,833	51,500	70,558
1957	3,601	9,158	12,759	5,412	51,000	69,171
1958	3,108	9,093	12,201	4,848	50,300	67,349
1959	2,983	9,000	11,983	4,297	49,700	65,980
1960	2,856	9,010	11,866	3,826	49,600	65,292
1961	2,341	9,078	11,419	3,593	49,000	64,012
1962	2,219	8,865	11,084	3,161	48,800	63,045
1963	1,756	8,878	10,634	2,155	49,400	62,189
1964	1,560	9,064	10,624	1,865	49,200	61,689

(c) *Ownership*

Of the 1,152 transit companies in the United States, under 7 percent are publicly owned. Publicly owned systems operate in 16 of the U.S. cities over 250,000 population: Oakland (Alameda-Contra Costa Transit District), Los Angeles, San Francisco, Miami, Chicago, Boston, Detroit, St. Louis, New York, Cleveland, Pittsburgh, Memphis, San Antonio, Dallas, Seattle, and Providence.

Most publicly owned systems are owned by municipalities and operated by them within the city limits and contiguous territory, but about a third are owned by public corporations such as the Alameda-Contra Costa Transit District, the Massachusetts Bay Transportation Authority (Boston), and the Port Authority of Allegheny County (Pittsburgh).

TABLE VIII.—*Distribution by types of ownership, number of transit companies, number of transit vehicles (Dec. 31, 1964)*

Ownership by—	Number of transit companies	Number of transit vehicles				
		Rapid transit cars	Surface street-cars	Trolley coaches	Motor-buses [1]	Total transit vehicles
State government or State agencies	0	0	0	0	0	0
Cities, counties, towns, special districts, public authorities or other local public bodies	77	8,568	882	1,136	19,000	29,520
Private, nonprofit organizations or co-operatives	0	0	0	0	0	0
Proprietary or profitmaking organizations	1,075	496	678	729	30,200	32,169
Total	1,152	9,064	1,560	1,865	49,200	61,689

[1] Estimated.

Source: American Transit Association.

(d) *Current Value*

One indication of the current value of urban mass transportation facilities is gross investment. As of 1964, over $4 billion was invested in the transit industry as a whole, including railway, trolley coach, and motorbus (table IX).

TABLE IX.—*Gross investment of the transit industry as of Dec. 31, 1940, 1945–64, segregated as to mode of service (50 States and the District of Columbia)*

[Thousands of dollars]

Year	Surface railway	Rapid transit	Total railway	Trolley coach	Motor bus	Industry total
1940	$1,574,600	$2,014,000	$3,588,600	$58,700	$451,800	$4,099,100
1945	1,570,000	2,050,000	3,620,000	78,500	569,500	4,268,000
1946	1,456,600	2,050,900	3,507,500	82,400	602,900	4,192,800
1947	1,279,100	2,050,900	3,330,000	97,800	656,100	4,083,900
1948	1,060,000	2,051,000	3,111,000	120,300	675,100	3,906,400
1949	998,000	2,112,000	3,110,000	139,300	697,100	3,946,400
1950	913,000	2,147,000	3,060,000	146,400	718,000	3,924,400
1951	811,000	2,186,000	2,997,000	164,400	743,700	3,905,100
1952	801,000	2,191,000	2,992,000	174,200	749,500	3,915,700
1953	780,000	2,200,000	2,980,000	172,200	753,600	3,905,800
1954	692,000	2,250,000	2,942,000	166,900	759,600	3,868,500
1955	616,000	2,286,000	2,902,000	161,900	762,600	3,826,500
1956	577,000	2,303,000	2,880,000	149,900	772,500	3,802,400
1957	485,000	2,385,000	2,870,000	143,000	785,700	3,798,700
1958	334,000	2,497,000	2,831,000	139,000	777,700	3,747,700
1959	296,000	2,560,000	2,856,000	125,000	796,700	3,777,700
1960	259,000	2,636,000	2,895,000	117,000	817,000	3,829,000
1961	235,000	2,732,000	2,967,000	115,000	837,000	3,919,000
1962	229,000	2,813,000	3,042,000	106,000	854,000	4,002,000
1963	175,000	2,901,000	3,076,000	70,000	879,000	4,025,000
1964	165,000	2,979,000	3,144,000	65,000	897,000	4,106,000

Source: American Transit Association.

B. Costs and Charges

1. REVENUES AND COSTS

No analysis of transit costs can be meaningful without consideration of the changes in transit use. Prior to World War II, the peak of transit traffic was reached in 1926. In that year, over 17 billion passengers were carried by all modes of urban mass transit in the United States (table X). Following 1926, changes in our society brought about an increase in the use of private transportation and a corresponding decrease in mass transit ridership. Automobiles became cheaper and more plentiful and roads improved. As urban areas expanded, the private automobile became more useful as a flexible, rapid means of transportation. Between 1935 and 1960, urban population increased about 60 percent, estimated automobile travel in urban areas (in miles) increased by 170 percent, while mass transit rides declined about 25 percent. This trend of decreasing use of mass transit facilities has continued to the present despite a period during World War II when restrictions were placed on the use of the private automobile. The declining volume of passengers was accompanied by a decline in transit operating revenues, as shown in table XI.

Long-Term Trend of Traffic

Table X.—*Total passengers carried on transit lines of the United States*

[In millions]

Year	Electric railways			Trolley coaches	Motor-buses	Total
	Rapid transit	Surface	Total			
1912	1,041	11,109	[1] 12,150	----------	----------	12,150
1920	1,792	13,770	15,562	----------	----------	15,562
1925	2,264	12,924	15,188	----------	1,484	16,672
1926	2,350	12,895	15,245	----------	2,009	17,254
1930	2,559	10,530	13,089	16	2,481	15,586
1935	2,236	7,286	9,522	96	2,625	12,243
1940	2,382	5,951	8,333	542	4,255	13,130
1945	2,698	9,426	12,124	1,298	9,946	23,368
1946	2,835	9,027	11,862	1,354	10,247	23,463
1947	2,756	8,096	10,852	1,398	10,374	22,624
1948	2,606	6,506	9,112	1,558	10,759	21,429
1949	2,346	4,839	7,185	1,691	10,193	19,069
1950	2,264	3,904	6,168	1,686	9,447	17,301
1951	2,189	3,101	5,290	1,658	9,227	16,175
1952	2,124	2,477	4,601	1,666	8,901	15,168
1953	2,040	2,036	4,076	1,587	8,280	13,943
1954	1,912	1,489	3,401	1,387	7,643	12,431
1955	1,870	1,207	3,077	1,223	7,269	11,569
1956	1,880	876	2,756	1,163	7,062	10,981
1957	1,843	679	2,522	1,003	6,903	10,428
1958	1,815	572	2,387	843	6,540	9,770
1959	1,828	521	2,349	749	6,498	9,596
1960	1,850	463	2,313	657	6,425	9,395
1961	1,855	434	2,289	601	5,993	8,883
1962	1,890	393	2,283	547	5,865	8,695
1963	1,836	329	2,165	413	5,822	8,400
1964	1,877	289	2,166	349	5,813	8,328

[1] From U.S. Census of Electrical Industries; remaining figures are American Transit Association estimates.

TABLE XI.—*Trend and distribution of transit operating revenue in the United States by types of service, 1940 and 1945–64, inclusive (50 States and the District of Columbia)*

[In millions]

Calendar year	Railway			Trolley coach	Motorbus	Grand total
	Surface	Subway and elevated	Total			
1940	$328.3	$128.3	$456.6	$25.5	$256.7	$738.8
1945	560.1	149.4	709.5	71.2	605.5	1,386.2
1946	543.6	157.5	701.1	74.5	626.4	1,402.0
1947	510.4	156.6	667.0	79.3	649.5	1,395.8
1948	474.6	191.7	666.3	92.8	733.8	1,492.9
1949	402.5	218.0	620.5	114.4	760.5	1,495.4
1950	361.7	216.4	578.1	124.1	753.9	1,456.1
1951	318.9	214.7	533.6	134.1	808.9	1,476.6
1952	279.7	213.9	493.6	149.8	862.3	1,505.7
1953	250.6	239.5	490.1	153.5	873.6	1,517.2
1954	204.2	269.2	473.4	143.9	858.8	1,476.1
1955	175.5	264.3	439.8	133.2	857.7	1,430.7
1956	139.4	271.4	410.8	130.0	879.7	1,420.5
1957	115.3	267.6	382.9	117.5	889.7	1,390.1
1958	99.1	266.5	365.6	103.2	885.2	1,354.0
1959	93.0	272.2	365.2	91.0	924.9	1,381.1
1960	87.6	281.8	369.4	81.9	955.9	1,407.2
1961	79.9	285.7	365.6	78.7	945.4	1,389.7
1962	73.3	293.0	366.3	76.0	961.2	1,403.5
1963	61.2	287.4	348.6	56.2	985.8	1,390.6
1964	55.6	295.8	351.4	46.4	1,010.3	1,408.1

Source: American Transit Association.

Changes occurred in these years also in the use of transit facilities during the day. Due to an increasing separation of residential and employment centers, greater use of the automobile for recreation and shopping, and the postwar shift from a 6- to a 5-day workweek, mass transit riding has become highly concentrated in the 4-hour period of each working day Monday through Friday when persons commute to and from their places of employment. This concentration of ridership in a brief period of time is one of the main reasons for continuing high costs in the transit industry despite an overall reduction in the number of passengers. Equipment and manpower needed for the peak hours are not used to their greatest capacity during the off-peak period.

Table XII shows a deteriorating financial picture for mass transit since the war. A striking change has been the decline in the ratio of operating income to gross operating revenue. This ratio declined from 10.77 percent in 1945 to 0.5 percent in 1958. It rose again from 1959 to 1962 but fell in 1963 and 1964 when operating deficits occurred.

One of the largest items accounting for an increase in operating expenses has been labor. In many cities the cost of labor has increased 100 percent in this period. The cost of replacement parts and fuel is also about double what it was before World War II. Part of the labor and fuel costs are due to traffic congestion, not met by corresponding increase in passenger revenue. It is estimated that delays in downtown traffic absorb at least 18 percent of the total vehicle running time.

TABLE XII.—*Results of transit operations in the United States, 1940, 1945 to 1964, inclusive (50 States and the District of Columbia)*

[Dollar amounts in thousands]

Year	Operating revenue	Payroll	Operating expenses except payroll	Total operating expenses	Net revenue	Taxes	Operating income	Payroll percent of operating expenses	Percentage distribution (percent of operating revenue)					
									Payroll	Other operating expenses	Total operating expenses	Net revenue	Taxes	Operating income
1940	$738,800	$360,600	$238,860	$599,460	$139,340	$62,870	$76,470	60.15	48.81	32.33	81.14	18.86	8.51	10.35
1945	1,386,200	634,700	436,980	1,071,680	314,520	165,240	149,280	59.22	45.79	31.52	77.31	22.69	11.92	10.77
1946	1,402,000	715,500	418,020	1,133,520	268,480	129,400	139,080	63.12	51.03	29.82	80.85	19.15	9.23	9.92
1947	1,395,800	792,600	450,540	1,243,140	152,660	105,270	47,390	63.76	56.78	32.28	89.06	10.94	7.54	3.40
1948	1,492,900	831,300	516,260	1,347,560	145,340	101,530	43,810	61.69	55.68	34.58	90.26	9.74	6.80	2.94
1949	1,495,400	843,100	498,810	1,341,910	153,490	89,350	64,140	62.83	56.38	33.36	89.74	10.26	5.97	4.29
1950	1,456,100	837,000	462,890	1,299,890	156,210	89,590	66,620	64.39	57.48	31.79	89.27	10.73	6.15	4.58
1951	1,476,600	874,100	460,490	1,334,590	142,010	95,820	46,190	65.50	59.20	31.18	90.38	9.62	6.49	3.13
1952	1,505,700	905,300	467,830	1,373,130	132,570	102,610	29,960	65.93	60.13	31.07	91.20	8.80	6.81	1.99
1953	1,517,200	915,300	458,710	1,374,010	143,190	97,910	45,280	66.62	60.33	30.23	90.56	9.44	6.45	2.99
1954	1,476,100	897,200	443,440	1,340,640	135,460	90,280	45,180	66.92	60.78	30.04	90.82	9.18	6.12	3.06
1955	1,430,700	866,300	414,510	1,280,810	149,890	93,970	55,920	67.64	60.55	28.97	89.52	10.48	6.57	3.91
1956	1,420,500	854,300	420,600	1,274,900	145,600	89,690	55,910	67.01	60.14	29.61	89.75	10.25	6.31	3.94
1957	1,390,100	842,300	422,840	1,265,140	124,960	88,000	36,960	66.58	60.59	30.42	91.01	8.99	6.33	2.66
1958	1,354,000	833,300	436,110	1,269,410	84,590	77,810	6,780	65.64	61.54	32.21	93.75	6.25	5.75	.50
1959	1,381,100	834,400	435,490	1,269,890	111,210	85,440	25,770	65.71	60.42	31.53	91.95	8.05	6.19	1.86
1960	1,407,200	857,300	432,550	1,289,850	117,350	86,660	30,690	66.47	60.92	30.74	91.66	8.34	6.16	2.18
1961	1,389,700	856,400	439,370	1,295,770	93,930	77,200	16,730	66.09	61.62	31.62	93.24	6.76	5.56	1.20
1962	1,403,500	878,100	427,900	1,306,000	97,500	77,800	19,700	67.24	62.56	30.49	93.05	6.95	5.54	1.41
1963	1,390,600	892,300	420,260	1,312,560	78,040	978,920	[1] 880	67.98	64.17	30.22	94.89	5.61	5.68	----------
1964	1,408,100	916,900	425,680	1,342,580	65,520	77,910	[1] 12,390	68.29	65.12	30.23	95.35	4.65	5.53	----------

[1] Deficit.

Source: American Transit Association.

In 1964, transit companies paid $78 million in taxes, approximately 57 percent of which were Federal and 43 percent State, county, and local. It is estimated that about 25 percent of all taxes paid by transit companies are of the franchise type. Frequently amounting to from 2 to 5 percent of gross revenues regardless of the financial position of the company, these were levied by municipalities when transit companies had a monopoly of local transportation and were taxed to pay for the privilege of using the city streets. They are retained in many instances, although the private automobile now offers direct competition to mass transit.

2. USER CHARGES

Rising costs and declining patronage made it necessary for transit systems to raise fares. Tables XIII and XIV show that the median fare increased from 7 cents in 1944 to 20 cents in 1963 in cities of 25,000 population and over. In 1944, no fare was over 10 cents. By 1963, 35 percent of the transit systems charged 25 cents and 32 percent, 20 cents for a single zone of travel.

TABLE XIII.—*Percentage distribution of cash fares in effect in U.S. cities having a population of 25,000 or more,[1] selected dates, 1944–63*

Cash fare (cents) [2]	Dec. 31, 1944	Sept. 1, 1950	Apr. 15, 1955	Sept. 15, 1960	Aug. 22, 1963
35	0	0	0	0	[3]
30	0	0	0	1.07	3.65
25	0	0	0	17.38	35.83
20	0	0	11.11	36.27	32.52
15	0	8.25	53.66	35.41	21.39
10	43.77	68.69	24.32	3.43	3.30
5	33.01	8.01	.21	0	0
Other	23.22	15.05	10.70	6.44	3.11
Total	100.00	100.00	100.00	100.00	100.00

[1] Each city system is counted as a unit. If 2 or more independent systems operate in a city, each is counted separately.
[2] Fares are separate fares for 1 zone of travel.
[3] Since August 1963, Akron and Youngstown, Ohio, have moved to 35-cent fares.

Source: American Transit Association.

TABLE XIV.—*Median and modal cash fares on public transportation lines in U.S. cities of 25,000 and over, selected years, 1944–63*

[In cents]

Year	Median fare	Most common fare
1944	7	10
1948	10	10
1950	10	10
1952	10	10
1954	15	15
1956	15	15
1958	15	15
1960	20	20
1961	20	20
1962	20	[1] 20–25
1963	20	25

[1] 34.22 percent of fares at each level.

Source: Data gathered by the American Transit Association.

C. Trend of Capital Outlays

No figures are available for capital outlays for mass transit facilities during the 1946–65 period with the exception of the expenditures made by State and local governments (listed in table XV).

Under the 1964 Urban Mass Transportation Act which first made Federal funds available for mass transit facilities and equipment, 44 projects have been approved from the passage of the act to the end of July 1966. These permit Federal capital grants of almost $157 million for transit facilities to be matched by local and State funds of $106 million.

Table XV.—*Capital outlays for transit facilities by State and local governments*

[In millions]

Year:	*Amount*	Year—Continued	*Amount*
1952	$67	1959	$102
1953	52	1960	94
1954	62	1961	120
1955	81	1962	90
1956	109	1963	168
1957	120	1963–64	155
1958	134	1964–65	242

Source: Bureau of the Census, "Governmental Finances," various issues.

D. Needs and Capital Requirements

Rapid population growth and increasing urbanization in the United States will require greatly augmented expenditures for mass transportation facilities. It is estimated that U.S. population will reach 250 million by 1980 and 350 million by 2000. In 1980, 75 percent of the U.S. population will be living in urban areas comprising only 2 percent of the land area. By that year, 40 urban complexes of over 1 million each will contain 140 million people.

The Institute of Public Affairs in a study completed in 1962 for the Housing and Home Finance Agency Administrator and the Secretary of Commerce estimated that mass transit needs (including commuter railroad as well as rapid transit and bus systems) would amount to $9.8 billion for the following decade. About $7.6 of this would be needed for commuter rail and rapid transit facilities.

The Department of Housing and Urban Development updated these estimates in 1966. It foresaw the capital needs of urban transportation from 1966 to 1975 as $10.9 billion, including $8.6 billion for rail facilities authorized or planned, $1 billion for possible future rail facilities, and $1.3 billion for bus replacements. The latter does not take into account bus system expansion or the replacement of such facilities as shops and administrative facilities. The American Transit Association estimates the normal number of bus replacements each year as in the neighborhood of from 2,500 to 3,000.

The following estimates were made of the major metropolitan rail transit system capital needs from 1966 to 1975: Atlanta, $329 million; Baltimore, $531 million; Boston, $590 million; Chicago, $930 million; Cleveland, $60 million; Los Angeles, $900 million; New York, $2,500 million; Philadelphia, $506 million; San Francisco, $1,230 million; Seattle, $111 million, and Washington D.C., $950 million. Table

XVI compiled by the American Transit Association gives details on some of the rapid transit and commuter railroad projects already authorized or in prospect at the present time.

It is difficult to break down capital needs on a yearly basis since so much depends upon the timing of the contemplated projects. HUD estimates, however, that almost $2 billion will be required in the next 3 years for the capital needs of the major metropolitan rail transit systems alone.

Sufficient knowledge of future conditions is also lacking to make a determination of how much of the capital outlays will be obtained from operating revenues and how much from Federal, State, and local government sources.

TABLE XVI.—*Rapid transit projects authorized or in prospect, urban transit industry*

System	Number of cars, cost	System cost and improvements
Allegheny Port Authority (Pittsburgh).		Studying the conversion of Castle Shannon streetcar line to rapid transit.
Atlanta	375 cars; $29,200,000	66-mile system. Estimated cost; $29,200,000.
Chicago Transit Authority	180 under construction by Pullman-Standard; $19,000,000.	$45,000,000 for new projects exclusive of cars (left). Extension of our John F. Kennedy (Northwest) Expressway. Longrange needs $309,000,000.
Cleveland Transit Authority	30 cars; $2,200,000	$13,200,000 total. Extension to Hopkins International Airport.
Massachusetts Bay Transportation Authority.	300; $22,500,000	$225,000,000 authorized for projects. Haymarket Sq. to Reading, Mass., an extension at $53,000,000. 11½ miles, Boston-Quincy-Braintree, the Old Colony Route. Conversion of Highland Branch from PCC cars to rapid transit.
Milwaukee		Special mass transit study committee formed. Talk of buying abandoned North Shore or developing rail transit.
New York City Transit Authority.	200 cars on bid, 600 cars on order, Budd Co.; $68,800,000.	Plans to buy an average of 200 cars per year. Various extensions proposed. DeKalb-Chrystie-Sixth Ave. tunnels $100,000,000. Manhattan-Queens tunnel (proposed), $86,000,000.
PATH (Trans-Hudson)	162 on order, St. Louis Car; $17,000,000; 50 optional.	Multi-million-dollar program to modernize physical, electrical equipment. Has option to take 50-plus additional cars for use in northern New Jersey connecting service.
Philadelphia	300 at least	Voters approve $87,330,000 bond issue to extend Broad St. subway. Sepact (Southeastern Pennsylvania Transportation Compact) plans to modernize 216.8 route miles of commuter lines for $103,200,000—modern cars, upgraded physical property.
San Francisco (BARTD)	450 cars; $71,000,000	75-mile system, $792,000,000.
Seattle		Puget Sound regional transportation study will recommend an overall transit plan.
Southern California Rapid Transit District (SCRTD, Los Angeles).	800 to 900; $69,000,000	58 miles proposed, $694,000,000.
Washington, D.C.	600 cars	24.9 miles, $431,000,000. Revised plan.

Source: Modern Railroads, January 1965.

Chapter 14

Airport Facilities*

A. Nature and Composition of Facilities

1. Description of Facilities

(a) *Physical Characteristics*

There are approximately 9,500 civil aircraft landing facilities in the United States composed of airports, heliports, and seaplane bases. The national airport system which is considered a key to our national aviation system is composed of approximately one-third of these, plus some additional planned facilities for a total of 4,106. Over 90 percent of this total are airports, as distinguished from heliports and seaplane bases. Although the airports comprising the national system range across the entire spectrum in size, physical characteristics, and service provided, each one has the same common function, i.e., to provide an area for the safe takeoff and landing of aircraft. In size, they range from as small as 20 acres up to 10,000 acres.

The runway orientation and configuration are probably the most variable of the physical characteristics. The orientation of a runway is primarily related to the direction, intensity, and duration of the surface winds and, to a lesser extent, to the topography and soil conditions of the site. Thus, a runway can be orientated in practically any compass heading. The configuration of the runway system in addition to being related to surface winds also has an effect on airport capacity. The configuration of the runway system can be a single runway layout or a multirunway layout. The multirunway configuration can be two or more intersecting runways, two parallel runways, or any combination of these. Each runway has an area surrounding it which is designated to be cleared of obstructions to permit safe ingress and egress of aircraft.

A taxiway system is normally provided to permit ground maneuvering of aircraft between runway and apron. Needless to say, more complex runway configurations require correspondingly more complex taxiway systems. Although the paved runways and taxiways are considered adequate for all aircraft traffic, the area between the taxiways and runways is graded to standards which minimize damage to aircraft in the event of inadvertent or accidental maneuver of the aircraft off of the paved surfaces.

The taxiway system can serve one multipurpose apron or several separate single-purpose aprons, such as passenger, cargo, parking, servicing, hangar, or holding. Such facilities as passenger terminals, cargo terminals, and hangars are contiguous to these aprons.

*Prepared by Federal Aviation Agency, Airports Service, System Planning Division, with minor editing by committee staff.

Each terminal area is served by access roads and parking areas designed to accommodate the various vehicles attracted to and used at the airport.

The airports comprising the national system serve both air carrier aviation and general aviation. General aviation is the term applied to that part of civil aviation engaged in pleasure, instructional, and commercial and business flying other than air carrier. The extent of activities within this segment of civil aviation precludes listing all the purposes and missions it fulfills.

Airport capacity is usually measured in terms of the number of air operations per unit of time. An air operation is defined as the takeoff or landing of one airplane. The runway system is therefore the major controlling element of the airport facility complex which influences airport capacity. In this context, a single runway has a capacity of from 140,000 to 150,000 annual operations depending upon the type of aircraft involved. Airport capacity can be increased by the construction of additional runways. The relative orientation of the runways in the airfield configuration greatly influences the increased capacity realized by the construction of additional runways. For instance, adding a runway to a 1 runway airport may increase the capacity to only 160,000 annual operations if the 2 runways intersect near their midpoints. If, on the other hand, the 2 runways intersect at their ends and the operations are away from the intersection 100 percent of the time, the capacity is increased to between 230,000 and 270,000 annual operations depending on the type of aircraft involved. The optimum two runway configuration for capacity is referred to as open-parallel runways. In this instance, the runways are separated at least 5,000 feet with the passenger terminal between the runways. The capacity for this scheme ranges from 300,000 to 400,000 annual operations depending on the type of aircraft involved. There are many variations of the examples cited with corresponding varying capacities.

(b) *Standards of Performance*

The standards to which airports in the national system are designed and constructed depend on the type of aircraft used to provide the service desired. These aircraft range from small single-engine, piston-powered general aviation aircraft weighing less than 12,500 pounds, to large multiengine turbojet, high-performance aircraft currently weighing up to 325,000 pounds. The runway length provided for these aircraft at sea level and 59° F. ranges from approximately 1,500 feet to as much as 10,500 feet. These lengths are increased for elevation and temperature above the standards of sea level and 59° F. The pavement strength of the entire airfield and the runway length are predicated on the specific critical airplane in the group of aircraft for which the airport is designed. The remaining standards, i.e., runway and taxiway widths and clearances, traverse and longitudinal grades, and approach clearances, are in turn related to the runway length provided. Visual aids including controls and power supply are provided to permit continuance of operations under adverse weather conditions.

2. EXISTING CAPITAL PLANT IN THE UNITED STATES

(a) *Distribution of Facilities*

As of mid-1965, 9,514 airports, seaplane bases, and heliports had been reported to the Federal Aviation Agency; and by December 1965, this number increased to 9,547. The individual State distribution of the reported facilities in mid-1965, and in December 1965, are provided in table I. State distribution of these facilities by population size of city is not available for the mid-1965 reported facilities; however, it is available for the December 1965 total facilities and is shown in table II.

The annual number of airports, seaplane bases, and heliports reported to this Agency from 1927 to date is included in table III. The increasing number of facilities reported from year to year should not be construed to mean that the additional number, in total, were constructed during that year. In many cases, a facility may have been in operation for several years and not reported to the Agency. Only when it is initially reported by the owner, operator, or manager, and/or first inspected by a representative of this Agency, is it recorded and included in the Agency statistics.

TABLE I.—*Number of airports, seaplane bases, and heliports, United States, Puerto Rico and Virgin Islands—Distribution by State and ownership, July and December 1965*

State	Number facilities, July 1965			Number facilities, December 1965			Ownership unknown
	Total	Publicly owned	Privately owned	Total	Publicly owned	Privately owned	
Alabama	115	72	43	113 (3)	72	41	0
Alaska	549	400	149	535 (4)	392	142	1
Arizona	183	78	105	181 (7)	79	102	0
Arkansas	117	56	61	120 (2)	57	63	0
California	625	252	373	638 (29)	237	401	0
Colorado	163	61	102	163 (5)	57	105	1
Connecticut	88	14	74	82 (5)	12	70	0
Delaware	19	3	16	18 (0)	3	15	0
District of Columbia	5	5	0	4 (1)	4	0	0
Florida	258	119	139	266 (15)	106	160	0
Georgia	158	77	81	157 (2)	77	80	0
Hawaii	48	18	30	46 (2)	16	30	0
Idaho	178	118	60	171 (7)	113	58	0
Illinois	318	77	251	322 (9)	65	257	0
Indiana	159	49	110	152 (6)	48	104	0
Iowa	212	72	140	215 (3)	77	138	0
Kansas	260	107	153	263 (0)	106	157	0
Kentucky	59	42	17	60 (3)	44	16	0
Louisiana	193	57	136	181 (3)	54	127	0
Maine	138	46	92	137 (2)	46	91	0
Maryland	77	17	60	79 (4)	14	65	0
Massachusetts	127	36	91	118 (9)	29	89	0
Michigan	235	114	121	241 (5)	115	126	0
Minnesota	240	111	129	237 (2)	112	125	0
Mississippi	147	64	83	150 (2)	65	85	0
Missouri	229	70	159	248 (9)	70	178	0
Montana	186	111	75	185 (6)	108	77	0
Nebraska	195	85	110	266 (5)	82	184	0
Nevada	76	36	40	74 (3)	35	39	0
New Hampshire	39	10	29	41 (0)	14	26	1
New Jersey	132	19	113	128 (4)	17	111	0
New Mexico	114	52	62	112 (3)	52	60	0
New York	324	56	268	322 (8)	54	268	0
North Carolina	167	46	121	170 (3)	47	123	0
North Dakota	170	66	104	173 (2)	67	106	0
Ohio	401	55	346	399 (7)	54	345	0
Oklahoma	196	91	105	193 (4)	88	105	0
Oregon	187	78	109	183 (10)	77	106	0
Puerto Rico	20	14	6	17 (2)	10	7	0

See footnote at end of table.

TABLE I.—*Number of airports, seaplane bases, and heliports, United States, Puerto Rico and Virgin Islands—Distribution by State and ownership, July and December 1965*—Continued

State	Number facilities, July 1965			Number facilities, December 1965			Ownership unknown
	Total	Publicly owned	Privately owned	Total	Publicly owned	Privately owned	
Pennsylvania	475	64	411	462 (10)	63	399	0
Rhode Island	14	7	7	11 (1)	5	6	0
South Carolina	99	43	56	95 (1)	43	52	0
South Dakota	98	57	41	102 (1)	60	42	0
South Pacific	5	4	1	5 (0)	4	1	0
Tennessee	109	53	56	107 (4)	52	55	0
Texas	833	214	619	838 (15)	210	628	0
Utah	68	50	18	69 (1)	51	18	0
Vermont	38	12	26	37 (0)	13	24	0
Virginia	112	36	76	112 (3)	37	75	0
Virgin Islands	2	2	0	2 (0)	2	0	0
Washington	214	110	104	203 (16)	97	106	0
West Virginia	53	15	38	54 (1)	15	39	0
Wisconsin	202	84	118	204 (2)	87	117	0
Wyoming	85	42	43	86 (2)	42	44	0
Total	9,514	3,637	5,877	9,547 (253)	3,556	5,988	3

NOTE.—The June 1965 total facilities includes, as facilities, 253 undesignated and unmarked helicopter landing areas which are located at airports. These undesignated areas have been deducted from the December 1965 totals, and are indicated in parentheses should their use be required for determining trends.

TABLE II.—*Distribution of airposts, seaplane bases, and heliports by population size of associated city, December 1965*

State	50,000 and over	100,000 to 499,999	50,000 to 99,999	10,000 to 49,999	1,000 to 9,999 [1]	Under 1,000 [1]	Unknown [2]
Alabama	2	5	2	19	66	19	0
Alaska	0	0	0	10	31	211	283
Arizona	4	9	0	21	65	60	22
Arkansas	0	3	4	16	72	23	2
California	67	43	27	146	224	96	35
Colorado	4	3	5	12	67	47	25
Connecticut	2	9	4	23	40	2	2
Delaware	0	1	0	2	12	2	1
District of Columbia	4	0	0	0	0	0	0
Florida	25	31	2	50	91	54	13
Georgia	3	12	2	38	84	17	1
Hawaii	1	0	0	2	12	6	25
Idaho	0	0	1	16	47	60	47
Illinois	10	14	15	56	138	63	26
Indiana	6	10	4	44	64	15	9
Iowa	0	2	6	18	112	49	28
Kansas	1	19	0	41	112	74	16
Kentucky	4	2	1	19	30	1	3
Louisiana	4	18	2	37	81	29	10
Maine	0	2	1	10	61	34	29
Maryland	12	0	1	20	16	20	10
Massachusetts	8	15	7	37	36	12	3
Michigan	15	19	5	22	110	56	14
Minnesota	7	3	0	20	120	66	21
Mississippi	1	3	0	26	86	34	0
Missouri	9	7	6	22	102	83	19
Montana	0	0	3	11	63	75	33
Nebraska	0	7	1	12	104	102	40
Nevada	0	5	4	1	19	38	7
New Hampshire	0	0	2	7	25	5	2
New Jersey	11	10	0	36	37	15	19
New Mexico	0	5	1	25	32	47	2
New York	37	16	6	58	126	49	30
North Carolina	0	17	4	60	80	6	3
North Dakota	0	0	1	11	57	62	42
Ohio	41	32	4	68	151	74	29
Oklahoma	10	9	1	29	102	40	2
Oregon	2	3	3	25	63	61	26
Puerto Rico	3	1	2	9	1	1	0

See footnotes at end of table.

TABLE II.—*Distribution of airports, seaplane bases, and heliports by population size of associated city, December 1965*—Continued

State	50,000 and over	100,000 to 499,999	50,000 to 99,999	10,000 to 49,999	1 000 to 9,999 [1]	Under 1,000 [1]	Unknown [2]
Pennsylvania	18	35	14	62	208	100	25
Rhode Island	1	0	0	5	3	2	0
South Carolina	0	11	2	16	56	7	3
South Dakota	0	1	1	9	43	40	8
South Pacific	0	0	0	1	0	0	4
Tennessee	4	14	1	21	51	16	0
Texas	55	40	13	129	417	163	21
Utah	0	5	1	5	38	12	8
Vermont	0	0	0	6	17	12	2
Virginia	2	6	9	32	31	22	10
Virgin Islands	0	0	0	2	0	0	0
Washington	6	10	1	29	78	72	7
West Virginia	0	2	4	11	20	9	8
Wisconsin	2	7	1	20	96	35	43
Wyoming	0	0	0	6	36	27	17
Total	381	466	174	1,433	3,833	2,225	1,035

[1] Requested breakdown of population group 2,500 to 9,999 and under 2,500 is not available.
[2] Privately owned facilities which serve only the owner or small group; therefore, the actual population is unknown.

TABLE III.—*Recorded airport facilities, 1927–65*

Year (Dec. 31):	*Number reported airports, seaplane bases, and heliports*
1927	1, 036
1930	1, 782
1933	2, 188
1936	2, 342
1939	2, 280
1942	2, 809
1945	4, 026
1946	4, 490
1947	5, 759
1948	6, 414
1949	6, 484
1950	6, 403
1951	6, 237
1952	6, 042
1953	6, 760
1954	6, 977
1955	6, 839
1956	7, 028
1957	6, 412
1958	6, 018
1959	6, 426
1960	6, 881
1961	7, 715
1962	8, 804
1963	8, 818
1964	9, 490
1965	9, 547

(b) *Ownership Pattern*

The individual State totals of publicly and privately owned airports, seaplane bases, and heliports reported in mid-1965 and in December 1965, are included within table I. A publicly owned facility is one owned by State governments, State agencies, cities, counties, towns, special districts, public authorities, or other local public bodies, and the Federal Government. A privately owned facility is one owned by private, nonprofit organizations and cooperatives, proprietary or profitmaking organizations and individuals.

Private airports (5,988 in number) constitute 63 percent of the Nation's total airport facilities. Of the 3,556 public airports in operation, only a small percentage is owned and operated by State governments or State agencies. Counties, cities, towns, public authorities, or other metropolitan or local public bodies own, operate, or lease for operation by far the larger percentage of publicly owned airports.

Federal Government ownership and operation of airports is very limited. The two airports used by air carriers serving the Nation's Capital are owned and operated as Federal airports. Employees of the airport management at these two airports are Federal employees.

The current value, calendar year 1965, of publicly owned airport facilities including real estate is estimated to be $5 billion.

B. Cost and User Charges

1. CONSTRUCTION AND OPERATING COSTS

The range of typical initial capital costs of airport construction is indicated in table IV. The construction costs are identified by type of airport facility, and are estimated both in total amount and on the basis of an accepted standard unit of measure. For most facilities this unit of measure is the cost per linear foot, per square foot, or per square yard. Costs for terminal air traffic control (ATC) facilities and navigational visual aids are estimated as total facility costs. Typical costs are shown for four types of airports in table IV in order to present the range of both scope and cost. Also, two ranges of facilities have been included for airports used by airlines and for those used by general aviation exclusively. All facilities are normally expected to have at least a 20-year long-time durability and are considered to be permanent facilities. This is consistent with the policy and procedures followed for other public work facilities.

The range of typical annual airport maintenance and operation expenses are identified by the type of airport facility in table V and, thus, can be directly associated with the cost breakdown of table IV. Operating expenses have been given as a separate item for those facilities where this expense represents a significant outlay relative to the total maintenance and operating costs. For example, major operating expenses are associated with electrical utility for lighted runway and taxiway facilities and for salaries of personnel operating ATC facilities.

TABLE IV.—*Range of typical airport construction costs*

[Historical dollar costs]

AIRPORTS USED BY AIRLINES

Airport facilities	Large		Small	
	Total	Per unit	Total	Per unit
Landing area:				
Runway (lighted)	$1,000,000–$8,000,000	[1] $200–$800	$500,000–$2,000,000	[1] $100–$500
Taxiway (lighted)	500,000–1,000,000	[1] 75–150	300,000–700,000	[1] 50
Aprons	500,000–2,000,000	[2] 9	50,000–150,000	[2] 6
Aircraft hangar facilities	500,000–5,000,000	[3] 5–25	200,000–500,000	[3] 2–15
Terminal area:				
Building (administration)	10,000,000–20,000,000	[3] 50–75	2,000,000–5,000,000	[3] 25–50
Auto parking and ground access	100,000–200,000	[2] 2–4	50,000–100,000	[2] 2–4
Servicing facilities (airport)	100,000–200,000	[3] 10–25	50,000–100,000	[3] 5–15
Terminal ATC facilities	900,000	----------	450,000	----------
Navigational visual aids	1,095,000	----------	375,000	----------

See footnotes at end of table.

TABLE IV.—*Range of typical airport construction costs*—Continued

AIRPORTS USED BY GENERAL AVIATION ONLY

	Large (public)		Small (private)	
	Total	Per unit	Total	Per unit
Landing area:				
Runway (lighted)	$500,000–$1,000,000	[1] $100–$300	$90,000–$500,000	[1] $30–$150
Taxiway (lighted)	300,000– 700,000	[1] 50	10,000	[1] 25
Aprons	50,000– 150,000	[2] 6	5,000– 10,000	[2] 2–4
Aircraft hangar facilities	100,000– 500,000	[3] 2–5	[4]	[4]
Terminal area:				
Building (Administration)	100,000– 500,000	[3] 15–35	[4]	[4]
Auto parking and ground access	10,000– 50,000	[2] 2–4	1,000– 5,000	[2] 1–4
Servicing facilities (airport)	20,000– 50,000	[3] 5–10	[4]	[4]
Terminal ATC facilities	340,000		[4]	[4]
Navigational visual aids	85,000		7,000	

[1] Per linear foot.
[2] Per square yard.
[3] Per square foot.
[4] Not available.

TABLE V.—*Range of typical annual airport maintenance and operation costs*

AIRPORTS USED BY AIRLINES

Airport facilities	Large		Small	
	Total	Per unit	Total	Per unit
Landing area:				
Runway (lighted):				
Maintenance	$5,000–$10,000	[1] $1.00	$2,000– $5,000	[1] $0.50
Operation	2,000– 5,000	[1] .50	1,000– 3,000	[1] .30
Taxiway (lighted):				
Maintenance	3,000– 7,000	[1] .50	1,000– 3,000	[1] .25
Operation	3,000– 7,000	.50	1,000– 3,000	[1] .30
Aprons:				
Maintenance	2,000– 5,000	[2] .10	500– 1,000	[2] .05
Operation	5,000– 10,000	[2] .10–.50	1,000– 3,000	[2] .10–.25
Aircraft hangar facilities:				
Maintenance and operation	10,000– 15,000	[3] 1.00–2.00	5,000– 10,000	
Terminal area:				
Building (administration):				
Maintenance and operation	25,000– 50,000	[3] 1.00–2.00	10,000– 15,000	
Auto parking and ground access, maintenance and operation	5,000– 10,000	[2] 5.00–0.25	2,000– 5,000	[2] .05–.15
Servicing facilities (airport) maintenance and operation	10,000– 25,000	[3] 1.00–2.00	5,000– 10,000	
Terminal ATC facilities:				
Maintenance	100,000		75,000	
Operation	200,000		125,000	
Navigational visual aids, maintenance and operation	100,000		50,000	

See footnotes at end of table.

TABLE V.—*Range of typical annual airport maintenance and operation costs*—Continued

AIRPORTS USED BY GENERAL AVIATION ONLY

Airport facilities	Large (public)		Small (private)	
	Total	Per unit	Total	Per unit
Landing area:				
Runway (lighted):				
Maintenance	$2,000–$5,000	[1] $0.50	$800	[1] $0.25
Operation	1,000– 3,000	[1] .30	900	[1] .30
Taxiway (lighted):				
Maintenance	1,000– 3,000	[1] .25	200	[1] .25
Operation	1,000– 3,000	[1] .30	300	[1] .30
Aprons:				
Maintenance	500– 1,000	[2] .05	150	[2] .05
Operation	1,000– 3,000	[2] .10–.25	150–500	[2] .05–.25
Aircraft hangar facilities, maintenance and operation	2–000– 5,000		(4)	(4)
Terminal area:				
Building (administration), maintenance and operation	5,000–10,000		(4)	(4)
Auto parking and ground access maintenance and operation	500– 1,000	[2] .05–.15	100–500	[2] .05–.10
Servicing facilities (airport) maintenance and operation	2,000– 5,000		(4)	(4)
Terminal ATC facilities:				
Maintenance	15,000		(4)	(4)
Operation	75,000		(4)	(4)
Navigational/visual aids: Maintenance and operation	15,000		2,000	

[1] Per linear foot.
[2] Per square yard.
[3] Per square foot.
[4] Not available.

Annual maintenance and operation expenses vary widely depending upon the degree of maintenance assumed under the individual leasing policy of the owner, and on the degree of services required. At large metropolitan airports the public services constituting annual maintenance and operating expenses extend to police controls, passenger information, operation of nurseries, first-aid stations, etc. Frequently, at small community airports, the only expense to the community is the mowing of the grass. To a very large degree the expenses of the owning public agency depend upon its leasing policy. For example, many small communities have a commercial, rent-paying tenant who sells gas, offers flight services, and takes care of what maintenance and operating burdens the owning municipality incurs. At most publicly owned (i.e., municipal) airports, there is an annual budget for total expenses.

2. USER CHARGES

The range of typical average user charges is indicated in table VI These charges are identified by type of facility used and on the basis of typically accepted fees, admission, lease payments and rentals found within the industry. Included within table VI is an indication of the nonapplicability of particular services at one type of airport or another.

TABLE VI.—*Range of typical airport user charges*

Airport facilities	Airports used by airlines		
	Large		Small per unit
	Total	Per unit	
Landing area, landing fee	$100,000 to $150,000 at 6 to 18 each.	(Air carrier: 15 to 35 cents) (1,000 pounds gross maximum weight.)	$1 to $25 per takeoff or landing.
Aircraft service area:			
Hanger fees	$50,000 to $200,000		
Single-engine aircraft		$75 to $100 per month	$50 to $75 per month.
Multiengine light		$100 to $150 per month	$75 to $100 per month.
Multiengine heavy		$150 to $200 per month	$100 to $200 per month.
Terminal area:			
Tie-down fee		$1 to $20 each	$1 to $5 each.
Building concession space rental.	$200,000 to $250,000	$6 to $12 per square foot per year.	$3 to $9 per square foot per year.
Building administration space rental.	$150,000 to $200,000	$2 to $9 per square foot per year.	$1 to $6 per square foot per year.
Observation deck fee		10 to 25 cents per person.	Free.
Ground transportation support.	$150,000 to $200,000		
Vehicle parking fee		25 to 50 cents per hour.	25 cents per hour.
Aviation activities:			
Aircraft rental (available)		$50-100/hour (heavy)	$25 to $50 per hour (light).
Flight instruction fee		(1)	$10 to $20 per multi-engine.
Ground school fee		(1)	$40 each.
Industrial facility rental	$150,000 to $200,000		
Total user charge revenue	$0.5 to $1 million		

Airport facilities	Airports used by General Aviation only	
	Large (public)	Small (private)
	Per unit	*Per unit*
Landing area, landing fee	$5 each	Free.
Aircraft service area:		
Hangar fees:		
Single-engine aircraft	$50 to $75 per month	$10 to $25 per month.
Multiengine light	$75 to $100 per month	$20 to $50 per month.
Multiengine heavy	$100 to $150 per month	$30 to $17 per month.
Terminal area:		
Tie-down fee	$1 each	Free.
Building concession space rental	$3 to $9 per SF per year	$1 to $6 per SF per year.
Building administration space rental	$1 to $3 per SF per year	(1).
Observation deck fee	Free	(1).
Ground transportation support		
Vehicle parking fee	Maximum 25 cents per hour	Free.
Aviation activities:		
Aircraft rental (available)	$15 to $25 per hour (large)	$10 to $15 per hour (small).
Flight instruction fee	$5 to $10 per single engine	(1).
Ground school fee	$20 each	(1).
Industrial facility rental		

[1] Not available.

There is evidence of a trend within the industry to record both costs and revenues in a fiscal accounting system which lends itself to determining the extent user charges are employed to pay for all or part of the services used. There is growing acceptance of the concept that airport user charges should be directly related to the measured costs of providing facilities used. This has not been the case in the past. Hopefully, the planned expenditures will be offset by revenues from user charges.

Only a relatively few public airports have been found to be truly operated on a self-sustaining financial basis. The reasons for this are manifold and complex. However, there are at least two notable causes for such inability. First, the predominant judgment of communities

to directly subsidize reasonable airport operating costs in return for the commerce attracted to the community. Second, the fact that most airports' fees are governed by their comparability to those charged by others, rather than being based upon the airports' factual operating expense.

Long-term self-sustaining airport operation depends upon achievement of that necessary traffic level which will recover the airport's expense through the assessment of reasonable user fees. Throughout the Nation there exist the "haves" and "have nots." Self-sustaining airport operations appear possible through assessment of appropriate user fees at most major terminal cities. Should Federal-aid cease to such airports, it is generally believed that the communities would exercise the wisdom necessary to continue their airports by adjusting such fees as necessary. Such airports are few in number, as illustrated by the fact that only five major airports accommodate nearly 20 percent of all airline flights. More critical is the question of whether the thousands of other communities can or would respond financially.

It is highly unrealistic to expect large public facilities to collect user charges exceeding the sum of prorated operating and capital costs. In those instances where privately owned facilities are operated on a self-sustaining basis with reasonable return on investment, it can usually be expected that there is some attracting force which establishes the level of demand. This may be superior service or even nonaviation related activities.

Under the Federal Aid Airport Program (FAAP), the Federal Government shares in the costs of land acquisition and construction for certain limited basic operational facilities and safety related items (namely, runways, taxiways, airfield lighting, service equipment buildings, etc.). The funds for FAAP are appropriated out of the general tax resources. For State and local governments, general tax resources and general obligation borrowings are used.

A large percentage of airport development projects has been accomplished based on local bond issues. The credit standing of local agencies, coupled with income tax exemptions for bond purchasers, have made this form of capital financing attractive. In addition, there has emerged a requirement on the part of local taxpayers to insist that airport development be financed by revenue bonds. Without the pledge of the total resources of the community, investors and purchasers of these bonds require evidence that the projected revenues to retire the bonds are reasonable and attainable. Moreover, to make such bonds marketable it is frequently necessary to encumber the airport with obligations to the bondholders relative to operatnig practices, rates and charges, etc. It is noteworthy that in some instances the principal users (airlines) have agreed to higher landing fees (user charges) in order to make the financing of much needed airport expansion attractive to bond purchasers, and to help sponsors raise their 50 percent share of funding under the FAAP.

C. Trends of Capital Outlays

ANNUAL TRENDS

Annual expenditures for airport facilities constructed inplace are indicated in table VII. The trend of expenditures is shown as a percentage change from year to year. Prior to 1952, amounts were

published only in aggregate and thus are not available. For 1947 through 1958, FAAP expenditures are shown in table VIII as Federal intergovernmental expenditures. (Flow of funds from tax revenue resources of one level of government to another are designated intergovernmental expenditures and revenues).

Expenditures for airports are influenced by the volume of traffic, by the continuing development of improved aircraft, and by more efficient ways of handling passengers and freight. The volume of traffic, in turn, is dependent upon the rate and nature of the Nation's economic growth, population growth and its regional distribution, and the types and values of commodities transported by air. The change in rate of expenditure reflects development in the state-of-the-art of the aviation industry—the introduction of turbojet airplanes, for example.

Total expenditures by level of government are given in table IX. That portion of total annual expenditures reported to be capital outlay is indicated in table X. Similarly, that portion designated for construction expenditure only is shown in table XI. The proportion accounted for by each level of government is also shown in each of these tables. Similar data are not available for private, nonprofit organizations and cooperatives, nor for proprietary or profitmaking organizations.

TABLE VII.—*Annual expenditures for publicly owned airports*

[Dollars in millions]

Year (December 31)	Total expenditures all governments	Percentage change (trend)
1952	$352	
1953	385	+9.4
1954	372	−3.4
1955	359	−3.5
1956	540	+50.4
1957	508	−5.9
1958	524	+3.1
1959	733	+39.9
1960	842	+14.9
1961	1,065	+26.5
1962	1,082	+1.6
1963	1,097	+1.4
1963 to 1964	1,109	+1.1
1964 to 1965	1,198	+8.0

Source: Bureau of the Census Governmental Finances, various issues.

TABLE VIII.—*Finances of publicly owned airports expenditures under the Federal-aid airport program* [1]

Fiscal year:	*Federal Government expenditures (intergovernmental) (millions)*
1947	----
1948	$5.1
1949	30.4
1950	33.2
1951	30.4
1952	32.8
1953	27.0
1954	17.5
1955	8.4
1956	16.5
1957	$20.6
1958	42.9
1959	56.6
1960	57.1
1961	64.8
1962	57.9
1963	51.5
1964	65.3
1965	70.6
1966 (estimated)	75.0

[1] For capital improvements.

Source: Federal Aviation Agency.

TABLE IX.—*Finances of publicly owned airports expenditures by level of government*

[Dollars in millions]

Year	Total all governments	Federal Government	Percent of total	State government	Percent of total	Local government	Percent of total
1959	$733	$425	58.0	$24	3.3	$284	28.7
1960	842	500	59.4	26	3.1	316	37.5
1961	1,065	643	60.4	36	3.4	386	36.2
1962	1,082	709	65.5	35	3.2	338	31.2
1963	1,097	736	67.1	31	2.8	330	30.1
1963 to 1964	1,109	750	67.6	40	3.6	319	28.8
1964 to 1965	1,198	783	65.4	46	3.8	369	30.8

Source: Bureau of the Census Governmental Finances, various issues.

TABLE X.—*Total capital outlay for publicly owned airports*

[Dollars in millions]

Year	Total all governments	Federal Government	Percent of total	State government	Percent of total	Local government	Percent of total
1959	$340	$110	32.4	$20	5.9	$210	61.7
1960	422	179	42.4	19	4.5	224	53.1
1961	543	229	42.2	27	5.0	287	52.8
1962	456	203	44.5	26	5.7	227	49.8
1963	428	203	47.4	21	4.9	204	47.7
1963 to 1964	393	175	44.5	26	6.6	192	48.9
1964 to 1965	371	110	29.6	35	9.4	226	61.0

Source: Bureau of the Census Governmental Finances, various issues.

TABLE XI.—*Airport construction expenditures only*

[Dollars in millions]

Year	Total all governments	Federal Government	Percent of total	State government	Percent of total	Local government	Percent of total
1959	$302	$96	31.8	$19	6.3	$187	61.9
1960	331	112	33.8	17	5.2	202	61.0
1961	433	140	32.3	27	6.3	266	61.4
1962	374	145	38.8	24	6.4	205	54.8
1963	310	125	40.3	21	6.8	164	52.9
1963 to 1964	279	97	34.8	25	9.0	157	56.2
1964 to 1965	312	81	26.0	34	10.9	197	63.1

Source: Bureau of the Census Governmental Finances, various issues.

TABLE XII.—*Revenue charges for air transportation*

[Dollars in millions]

Year	Total all governments	Federal Government	Percent of total	State government	Percent of total	Local government	Percent of total
1959	$128	$1	0.8	$5	3.9	$122	95.3
1960	150	3	2.0	7	4.7	140	93.3
1961	171	3	1.8	8	4.7	160	93.5
1962	210	7	3.3	10	4.8	193	91.9
1963	232	3	1.3	13	5.6	216	93.1
1963 to 1964	238	4	1.7	15	6.3	219	92.0
1964 to 1965	264	4	1.5	16	6.1	244	92.4

Source: Bureau of the Census Governmental Finances, various issues.

In recent years there has been a gradual annual increase in the outlay of FAAP funds for the growing number of development projects. This upward trend can be attributed to the constant need for more airport facilities to keep pace with the continuing growth of all types of aviation activity. Of the total annual capital outlays, about 90 percent is accounted for by projects sponsored by State agencies or by cities, counties, towns, or other local public bodies; the other 10 percent by projects developed and controlled by the Federal Government, including those airports located in or adjacent to national parks. About 35 of the 50 States have a grant-in-aid program for airports, but this source accounts for a small share of the total financing—only as much as 25 percent of project costs. Accordingly, the burden in most instances becomes a municipal burden.

Airport revenues collected by each level of government is shown in table XII. Specific information on other possible sources of financing such as gifts, bequests, donations, fund-raising drives, etc., is not available.

During the period 1947–65, the combined capital outlay of Federal and sponsor funds for eligible items of public airport development under the Federal-aid airport program, including the acquisition of land, amounted to approximately $1,669 million. Federal Government expenditures by year are shown in table VIII. The Federal portion obligated was $825 million, programed for over 6,000 projects at over 2,000 airports. The local funding amounting to $848 million does not include additional sponsor funds provided for items ineligible for Federal participation, such as terminal buildings, hangars, parking lots, and other items not related to operational safety. During the period 1956–66, sponsor requests exceeded actual Federal allocations by an average of $86 million a year. In addition, it is estimated that approximately $1.5 billion in real property assets, based on GSA and War Assets Administration records, were conveyed to local sponsors under the Surplus Property Act of 1944, as amended.

Local and State governments financed 76 percent of all airport development accomplished during the 5-year period, 1960–64. With regard to the source of capital financing, the percentages were 68 percent local funds, 8 percent State funds, and 24 percent Federal funds.

A recent survey of a fairly representative cross-section of airport management indicates that the percentage distribution of the total amount of airport capital financing was as follows: (1) approximately 13 percent general obligation bonds; (2) 68 percent revenue bonds; and (3) 19 percent from "other" sources. Airport revenue bond financing in excess of $91 million occurred at large hub airports and only $75,000 at lesser hub airports; in fact, the lowest airline activity airports (nonhub) resorted wholly to sources other than bond financing. Specific data on tax exempt municipal bonds and capital flotations in security markets in amounts and percentages by year are not available.

The 13,000 members of the National League of Cities indicated in their statement of national municipal policy for 1965 that they lack the financial capability for airport improvement and development. While the inability to financially respond is most acute at the intermediate and lesser sized municipalities, frequently large hub municipal-

ities are also unable to respond. Airport facilities are classified by the league as being of national significance and essential to the economy and commerce of the United States and, as such, warrant a permanent long-term Federal responsibility for financial support.

D. Needs and Prospective Capital Outlays

Airport facility development needs have been forecast for the period 1966–69 in the total amount of $1.96 billion. Of this amount, approximately $760 million (39 percent) is required for terminal building or terminal area development—work which is not eligible for Federal aid. The balance of $1.2 billion relates to needed development which is eligible for Federal aid. During the 4-year period, matching Federal aid approximating $300 million is expected to be available. Thus, the residual local and State financial burden will approximate an additional $600 million during this period.

Forecast data indicates that most major airports are acutely aware of the development needed to accommodate larger capacity aircraft of the future. Such aircraft will be introduced in quantity during the 1970–75 time period. The capital outlay requirements for FAAP eligible airport development are estimated at over $3 billion during the 10-year period 1966–75. Based on the assumption that work not eligible for Federal aid will continue to constitute approximately 40 percent of the total, it is estimated that the total capital outlay requirements for publicly owned airport development needs will approach $5 billion during this decade (see table XIII). Privately owned airports will require another $1 billion.

The key forecast factors considered in the projection of these capital outlay requirements are:

Over 179 million scheduled airline passengers annually by 1975—almost double today's figures.

Hours flown in general aviation aircraft to reach 30 million annually in 1975—an 85-percent increase over that recorded in 1965.

Transition from piston to turbine aircraft by 1970, alone, resulting in extending service from 112 airports at present to 346.

Introduction of supersonic transport, vertical short takeoff and landing, and larger capacity passenger-carrying aircraft in the latter half of this 10-year period requiring the construction and/or expansion of appropriate airport facilities.

An estimated $670 million FAAP eligible airport development cost requirement during the immediate 2-year period 1966–67; with a cumulative requirement of over $1.4 billion for the 5-year period 1966–70.

Attendant with the projected growth and technological advances in the field of aviation, the assumption that the continued FAAP capital outlay requirements for airport development and improvements over the following 5-year period (1971–75) will be equivalent to at least the preceding 5 years plus a 2-percent per annum construction cost increase.

Table XIII provides a summary of the estimated 1966–75 airport development capital outlay requirements by year. These estimates reflect aviation needs and are not a projection of probable expenditures.

Using the 1960 census as the basis, 57 percent of the estimated requirements is attributable to cities with populations of 50,000 or more; 38 percent to cities of 2,500 to 50,000; and 5 percent to cities, towns, and rural areas with populations under 2,500.

TABLE XIII.—*Publicly owned airport development capital outlay requirements, 1966–75*

[In millions]

Fiscal year	FAAP eligible requirements	Total development requirements	Source of funding	
			Federal [1]	Local and State
1966	$330	$475	$75	$400
1967	340	500	75	425
1968	255	500	75	425
1969	275	485	75	410
1970	260	480	75	405
1971	300	490	75	415
1972	300	495	75	420
1973	310	505	75	430
1974	320	520	75	445
1975	320	525	75	450
Total	3,010	4,975	750	4,165

[1] Assuming no change in FAAP funds of $75,000,000 annually.

NOTE.—Estimates of capital outlay.

As in the past, required annual capital outlays will be financed primarily by various levels of government, and to only a minor extent by private organizations. Expenditures by local and State governments for airport development have approximated a relatively stable 0.5 percent of their total annual expenditures for all governmental functions. Local and State governments financed 76 percent of all airport development accomplished during the 5-year period 1960–64, with the remaining 24 percent financed by the Federal Government.

Assuming that no change occurs in the amount of available FAAP funds ($75 million annually), it is estimated that the local and State governments' contribution must increase to approximately 80 percent of the total capital outlay required over the 1966–75 period. Using past experience as a guide, the estimated sources of financing these prospective capital outlays are as follows: revenue bonds—$3,330 million; general obligation bonds—$645 million; Federal Government grant assistance—$750 million; and other sources (State, bank loans, operational funds, tax levies, et cetera)—$250 million.

The ability to float bond issues which pledge future airport revenues to their retirement is, as noted previously, almost exclusively limited to a relatively few of the Nation's major airports. General obligation bond issues are usually possible at large and medium hub airports, but rarely possible at small and nonhub airports which generate from 0.25 percent to less than 0.05 percent of the total annual U.S. passenger traffic. The latter type of airports is almost totally dependent upon "other sources" for financing their needed airport development.

Small hub airports, which are concentrated in metropolitan areas ranging in population from 100,000 to 500,000 possess limited ability

to financially respond to their needed airport development, but are nevertheless faced with federally eligible development needs generally comparable to those of medium hub airports. The situation at non-hub airports is even more severe. The ability of such local governments to totally respond to their development needs is very doubtful.

It is obvious that the total estimated capital outlay requirements will exceed the amount that can be supplied by local and State funds. In addition to increasing direct Federal aid, a system of Federal loans might be made available to local and State governments to enable an orderly and timely development of the Nation's system of civil airports. It would enable development to proceed which would otherwise be delayed or not accomplished because of local government inability to arrange for the required capital financing.

In summary, private finances have not been available to supply the total capital expenditures necessary to build and improve airports on the general sustained basis required by civil aviation. States, municipalities, and other local political units alone have been unable to carry the entire capital burden attendant upon the provision of an adequate system of national airports. Federal, State, and municipality sharing of development costs distributes such costs to beneficiaries in as reasonably an equitable fashion as may be found in any system of public financing. It imposes a one-payment burden upon persons outside of the State in which the airport is located (Federal share), upon State residents a two-payment burden (Federal-State shares), and upon residents of the municipality a three-payment burden (Federal-State-local shares).

CHAPTER 15

Marine Port Facilities*

A. NATURE AND COMPOSITION OF PORTS AND TERMINAL FACILITIES

1. DESCRIPTION OF PORTS AND TERMINAL FACILITIES

(a) *General Physical Characteristics—Structures and Equipment*

A port is a shelter-harbor where marine terminal facilities are provided. The facilities consist of piers, wharves, and slips at which ships berth while loading or unloading cargo; cranes and other mechanical handling equipment which keep the cargo flowing between ship and terminal; transit sheds, warehouses, and other storage areas where goods may be stored for shorter or longer periods while awaiting distribution or sailing; and tracks and roadways which provide the access to and clearance from the terminal facility. Thus the terminal must be served by railroad, highway, or inland waterway connections. In brief, the harbor is a water area affording a natural or artificial haven for ships. Only when it has been developed for transacting business between ship and shore does a harbor become part of a port. Therefore, a port normally consists of a harbor plus marine terminal facilities.

A marine terminal is that part of a port or harbor which provides berthing, cargo handling, storage areas, and railroad and roadway clearance facilities. Terminal facilities are all those arrangements and systems, mechanical or otherwise, which make easy transference of passengers and commodities between ship and shore.

The three most common types of marine terminals, based on use of facility and the service they perform, are freight or cargo terminals where traffic is mainly mixed general cargo and a few passengers carried by freighters, passenger terminals where only passengers are embarked or disembarked with their baggage along with small amounts of lightweight cargo, and bulk cargo or specialized terminals where such products as petroleum, grain, coal, ore, and miscellaneous dry and liquid bulk cargoes are stored and handled. A fourth type of specialized facility is the container terminal which is increasing in number and importance and is specially designed for the accommodation of containerships and the handling and storage of van-sized containers in connection with the ocean transportation of containerized cargo.

Physically, a marine terminal may consist of only a single pier or wharf or it may comprise a number of piers and wharves grouped together and operated as a unit. Usually, the terminal includes open or covered storage facilities, or a combination of both, and often the entire facility is enclosed by a fence.

*Prepared by the Maritime Administration, U.S. Department of Commerce, with minor editing by committee staff.

In the United States, except for the specialized facilities for tanker vessels, there are two basic ship berthing facilities: (1) the simple straight pier or so-called finger pier, and (2) the marginal wharf or quay. A pier type of structure projects into a body of water at an angle with the shoreline normally permitting the berthing of vessels on the two sides of the pier and if the structure is sufficiently wide at the head of the pier as well. The wharf type of structure parallels the shoreline and provides berthing for vessels at its offshore face only.

(b) *Services Rendered*

Commercial areas: The port provides the whole range of services and the various kinds of accommodations which are usually grouped under the heading of terminal facilities for ships, passengers, and cargoes. The most important of all ship servicing elements are the berthing facilities provided at marine terminal facilities. Adequate berthing facilities in a port serve the demands of shipowners and steamship operators for piers and wharves at which to berth their ships and work cargo with safety, economy, and dispatch. Berthing facilities should be backed up by adequate transit sheds, warehouses, open storage areas, and sufficient mechanical cargo handling equipment to meet the needs of the entire marine terminal complex.

Other terminal facilities necessary for the servicing of ships include outfitting berths, repair berths, and bunkering berths. The common utilities available at these and other berths are electricity, fresh water, steam, and compressed air. Finally, specialized terminal facilities serve the needs of special purpose ships and their cargoes. These include petroleum storage and pipeline systems for loading and discharging bulk petroleum products, grain elevators for transferring bulk grain, loading and unloading equipment with conveyor belt systems and car dumper facilities for handling bulk coal and ore, wharf cranes fitted with grab buckets for handling miscellaneous bulk cargoes, conveyor systems for handling bananas and other delicate fruits, and swift handling arrangements for moving frozen meats and and produce between ship and cold storage facilities.

A port of reception may be illustrated as follows: Imported goods are first landed on the wharf apron from the ship; moved to the transit shed at shipside where they are checked, tallied, sorted, and inspected by customs; they are then transferred to a storage warehouse from where all or only part of the goods may be transported out of the port area by railroad, motor truck, lighter, barge, or coastwise vessel. The marine passenger terminal provides facilities for accommodating passenger ships and the ocean passenger traffic through the port. This passenger trade through the port requires terminals designed with certain special features for expediting baggage handling and customs inspection and other facilities such as restaurants, restrooms, offices for conducting immigration formalities, and port health requirements.

Most port administrative agencies have control over waterfront industrial site areas. The port authorities have developed so-called industrial zones for the purpose of encouraging industry participation in port expansion programs. These zones and the industrial plants which locate there are often served by modern port and terminal facilities as well as by connecting highways, railroads, electrical facili-

ties, utilities, et cetera. Many ports construct general or special purpose buildings for long-term lease to manufacturing and commercial firms. A small port generally reserves the waterfront area for its own public use, giving industrial leases in the immediate backland, together with constructing or providing such services needed for access to shipside, as pipeline, roadway, or rail spurs.

Agrarian interests of the port require specialized terminal facilities for receiving, storing, and shipping their products. If the commodities are bulk grains for export, the port must have a public grain elevator complete with berthing accommodations for ships and barges, loading spouts for transferring grain to ships, marine legs for unloading barges, grain storage bins, and a rail car and truck dumper system. Special facilities are also needed in the port for handling fresh fruits, produce, animal and dairy products, including refrigerator ships, cold storage plants, and refrigerated rail cars and trucks. Pipeline delivery systems and storage tanks are special facilities for liquid bulk vegetable products.

Most ports have set aside and developed certain areas of the harbor for the accommodation of yachts, small boats, and fishing vessels. These facilities afford shelter for small craft and provide the necessary mooring arrangements, boat slips, and marine railways or ramps for launching, drydocking, and removing boats from the water.

In a number of ports, and at outport locations, there are terminal facilities owned and operated by the Department of Defense. These include Army ports of embarkation, Navy operating bases, and miscellaneous installations such as ammunition piers and petroleum depots.

(c) *Quantitative Standards of Performance*

The practical operating capacity of a marine terminal is the volume of cargo which can be handled onto and through the terminal's precincts with reasonable efficiency and with only infrequent congestion. Generally, an ocean terminal's capacity is limited by any one of three distinct and independent functions: (1) the movement of cargo into or out of rail cars, trucks, and barges; (2) the transit storage of cargo at the terminal; and (3) the movement of cargo into or out of vessels.

At U.S. ports, the function dominating the practical operating capacity of a commercial marine terminal is the capacity for moving cargo into or out of vessels berthed at the terminal. This capacity is basically the product of two components. First is the cargo handling rate expressed in long-tons per day per berth which can be reasonably attained; second, the number of days in a year that the berths can be occupied under normal operating conditions.

Where a terminal contains a large number of berths, the occupancy per berth and the efficiency and capacity under these conditions can be high. At the other extreme, where a public terminal has only one or two berths, ship arrivals cannot be matched nearly as well with ship departures. Sailing shcedules can be more closely coordinated in the case of private terminals. Since the use which can be made of each berth is greater at terminals having a large number of berths,

the operating capacity of a terminal increases at a greater rate than the proportional increase in the number of berths.

Recorded observations in 1956–57 at large modern terminals in Pacific coast ports of the United States indicate an annual performance figure of 94,000 tons per berth for general cargo. In 1955–56, at a principal Atlantic coast port, performance records of both antiquated as well as the most modern berthing facilities shows that the average amount of cargo handled per berth per year was 59,444 tons. In 1957, the annual average volume of general cargo handled per berth at the same port increased to 63,055 tons. Considering all three U.S. coastal regions, an estimate of 75,000 tons of general cargo per berth per year was considered to be a fair average for the base year 1960.

It is expected that during the next 25 years improved conditions should result in an increase of general cargo handling efficiency. Accordingly, it is estimated that the handling rate at terminals on the Atlantic, gulf, and Pacific coasts will increase by 5,000 tons per berth for each 5-year period up to 81,000 tons per berth by 1966 and as high as 100,000 tons per berth by 1985.

It is estimated that the average annual tonnage capability of a Great Lakes berth would be about 20 to 25 percent less than the 75,000 tons per berth estimate for the three ocean coasts, or approximately 60,000 tons per berth annually for base year 1960. It is estimated that Great Lakes general cargo capacity will increase from the estimated 60,000 tons per berth per year in 1960 to 78,000 tons in 1966, thus reaching nearly the same berth capacity estimated for ocean coast ports for the same year.

A bulk petroleum berthing facility which is capable of loading and/or discharging petroleum products at a rate of 5,625 barrels or more per hour is considered to have a maximum capacity of 15,000 tons per 24-hour day. This is based on the assumption that the average T2 tanker can be loaded and/or discharged in one 24-hour day. By averaging the number of berths with a capability of handling less than 5,625 barrels per hour, it is estimated that each such berth has a daily maximum capacity of 9,500 tons.

Based on the number of petroleum berths and annual total capacity of 1,642.5 million tons estimated in base year 1960, the annual petroleum tonnage capacity of the two classes of petroleum berths on three ocean coasts is 3.83 million tons for a berth of 15,000 tons per day capacity (15,000×70 percent ×365), and an average of 2.42 million tons for a berth of 9,500 tons per day capacity (9,500×70 percent ×365).

The annual average petroleum tonnage capability on the Great Lakes is calculated to be 1.59 million tons per berth of 9,500 tons per day capacity (9,500 × 70 percent × 240 days).

It is estimated that, based on the storage capacities of the individual grain elevators on the Atlantic coast, an average annual minimum turnover of 5.6 times or a minimum volume of some 250 million bushels is required to keep the port elevators at a profitable level of operation. On the gulf coast these figures are 5.8 and 180 million bushels, respectively. Assuming an average turnover of grain through

the elevator of 5.7 times per year and based on elevator storage capacity of approximately 160 million bushels, the minimum annual handling for profitable operations on all three ocean coasts would be approximately 24.5 million tons or an average of about 400,000 tons per berth.

It was estimated that the 1960 annual capacity of coal berths on the three ocean coasts approximated 357.7 million tons (1.4 million tons × 70 percent to obtain effective vessel working time × 365 days). The total of 357.7 million tons divided by the total number of berths equals an annual average of 8.7 million tons per berth. The 1960 annual capacity of all coal berths on the Great Lakes was 285 million tons (1.7 × 70 percent × 240 days of navigation season). The total of 285 million tons divided by the total number of berths equals an annual average of 3.57 million tons per berth.

On the basis of New York's brief operating experience, it appears that the practical and effective capacity of a container berth for an operation like that of the Sea-Land Service, Inc., is about 500,000 tons per year. The Sea-Land terminal operations in the port of New York have reflected a containerized general cargo rate of 280 tons per gang-hour as compared to the approximate 15 tons per gang-hour normally handled on a conventional break-bulk cargo ship.

(d) *Qualitative Standards of Performance*

In general, port facilities are more than adequate on a quantitative basis to serve the maritime industry in times of peace and during war or crisis. Many are not adequate on a qualitative basis due to the current requirements imposed by technological developments in both sea and land transport. However, substantial numbers of these antiquated terminals are in the process of modernization or removal for new, modern, facilities.

In the past 17 years (Jan. 1, 1946–Dec. 31, 1962), a total of some $1,619,600,000 has been spent on piers, wharves, and docks alone in all U.S. ports for handling of bulk and general cargoes. This total figure was expended for waterside facilities only. It does not include many other construction projects in the broad field of port development which have also been built at these harbors, such as barge terminals, shipyards, harbor floating equipment, ferries, bridges, tunnels, expressways, airports, railroad yards, and other transportation facilities.

In the foreseeable future, there is no sign that this nationwide port building and modernization program will diminish in tempo. Impressive long-range building plans continue to be projected at seaboard ports.

In the economical design of piers and wharves an estimate of the commercial life of a structure is of considerable importance.

Some port engineers consider that it is not profitable to spend money for permanence of piers and wharves in excess of that required to give them a life of about 40 years. As few as 25 years has been allowed as the commercial life of wharf structures in some ports. On the other hand, there are ports where construction has been based on a life of 100 years. However, it is seldom advisable to make the total

initial cost of building a pier or wharf very large by installing a facility with a life longer than 50 years. There is no doubt that a port structure built to last over 50 years is cheaper in the long run, and requires smaller annual amortization and depreciation than with only a 25-year commercial life, because the period of amortization is longer and the longer lived structure more durable.

Currently, based on the commercial life of U.S. port facilities, the average life of pier and wharf structures has been estimated to be 48 years. The average life of other facilities has been calculated to be 46.5 years for transit sheds and storage warehouses; 43.5 years for cold storage plants, grain elevators, and bulk handling facilities; and 40 years for roadways, paving, and pier or wharf utility systems. The combined average life of all U.S. port structures is calculated to be 45.8 years.

2. EXISTING CAPITAL PLANT IN THE UNITED STATES

(a) *Number of Facilities*

As of mid-1962, there were some 2,100 marine terminal facilities or structures providing about 4,200 deepwater berths of all categories located in 170 U.S. ocean ports on the Great Lakes, and Atlantic, gulf, and Pacific coasts, including Alaska and Hawaii.

The 2,100 port terminal facilities do not represent all existing port berthing structures in the United States, but only those marine terminals which can accommodate oceangoing vessels alongside a pier or wharf with a minimum berthing depth of 20 feet or more in ports on the 3 ocean coasts, and 18 feet or more in ports on the Great Lakes. These facilities are the most significant ones from the standpoint of trade and commerce and make up the backbone of U.S. port facilities which serve the U.S. merchant fleet and foreign shipping throughout the world.

In addition to the 2,100 terminals selected, there are substantial numbers of marine port facilities located outside established port limits, on rivers, bays, canals, and connecting waterways.

Besides deep-draft berthing facilities for accommodating oceangoing vessels, there are innumerable shallow-draft facilities used to berth tugboats, barges, lighters, fishing vessels, yachts, harbor craft, and other types of light-draft floating equipment.

Military water terminals are a separate category of port facility and comprise a substantial number of individual pier and wharf structures which provide some 1,000 deep-draft berths on the 3 ocean coasts of the United States, not including Alaska and Hawaii. These include berthing facilities for handling ammunition, petroleum, and general cargo at military installations located within the immediate port area as well as those located outside the port limits such as isolated sites on the coast or at some distance inland on a river or other waterway.

(b) *Distribution of Facilities by State*

Thirty States account for nearly 170 primary ocean ports and over 2,100 individual marine terminal facilities. The distribution of these port terminal structures by State is contained in the following tabulation.

Distribution of port terminal facilities by State

State	Number of ports	Total number of terminals	Number and type of terminal						
			General cargo (shedded)	Open (no shed)	Bulk liquid	Grain	Coal	Ore	Other bulk
New York	6	334	163	91	35	17	6	1	21
California	21	237	105	85	31	5		2	9
Texas	10	157	64	31	56	3			3
Washington	11	132	45	51	21	7	1	1	6
Louisiana	4	113	46	36	25	3		1	2
Wisconsin	5	99	14	30	10	14	19	7	5
Florida	13	93	34	29	24				6
Ohio	8	91	10	29	6	5	16	13	12
Michigan	8	90	8	31	12		15	3	21
Maryland	1	89	20	48	10	3	1	1	6
Massachusetts	6	77	22	29	21		4	1	
Pennsylvania	5	75	34	19	13	3	5	1	
Virginia	4	68	17	26	12	2	6		5
Oregon	8	68	10	30	15	5		1	7
New Jersey	8	54	4	21	27				2
Illinois	2	46	10	21	2	9	1	2	1
Minnesota	2	44	8	18	1	6	3	5	3
Hawaii	9	41	31	7	3				
Alaska	15	29	13	12	4				
Alabama	1	29	6	13	6	1		1	2
North Carolina	2	23	8	4	8	1			2
Georgia	2	23	9	12	2				
Indiana	2	22		11	10	1			
South Carolina	3	21	8	8	1	1		1	2
Rhode Island	1	19	3	7	7		2		
Maine	3	18	6	4	6		1		1
Connecticut	3	13	1	6	5		1		
Mississippi	2	7	3	4					
New Hampshire	1	5		3	1		1		
Delaware	2	4	1	1	2				
Total	168	2,121	703	717	376	86	82	41	116

(c) *Distribution of Facilities by Size of Port City*

Out of a total of over 2,100 selected marine terminal facilities divided among nearly 170 ocean port cities in the United States, as few as 15 of them in the largest population group account for 46.9 percent or roughly one-half of the total terminal facilities in the country.

In descending order of population range, the next group of port cities number 27 and account for 23.1 percent or nearly one-fourth of the total terminal facilities.

The next three groupings of port cities, taken together in descending order of population range, total 87 ports and account for 27.7 percent of the total terminal facilities.

Based on descending order of population range, the last group of port cities number 39 and account for only 2.3 percent of the total capital plant.

Distribution of port terminal facility by size of port city (national summary)

	Number of ports	Number of facilities	Percent of total capital plant
Port city population:			
500,000 or more	15	995	46.9
100,000 to 499,999	27	490	23.1
50,000 to 99,999	19	215	10.1
10,000 to 49,999	45	294	13.9
2,500 to 9,999	23	78	3.7
2,500 or less	39	49	2.3
Grand total	168	2,121	100.0

(d) *Age Distribution of Facilities*

The date of construction was available for only 396 out of a total of 2,121 marine terminal facilities. Therefore, based on the number and percentage of the 396 terminals which were built during each of the required time frames and applying these percentages to the total of 2,121 terminal facilities, an estimate was obtained of the number of the total facilities built within 5 selected time periods.

Accordingly, the age distribution of the 2,121 marine terminal facilities which comprise the principal deep-draft berthing facilities on the Great Lakes and the three ocean coasts of the United States, including the States of Alaska and Hawaii, are presented in the following tabulaton:

Age distribution of port facilities [1]

	Number built (actual)	Percent of total (estimate)	Number built (estimate)
Date of construction:			
Before 1900	4	1.0×2,121	21
1900–20	70	17.7×2,121	375
1921–40	88	22.2×2,121	471
1941–60	192	48.5×2,121	1,029
Since 1961	42	10.6×2,121	225
Total	396		2,121

[1] Combined average age of pier and wharf structures is estimated to be 24.6 years.

(e) *Ownership of Facilities*

In the management and administration of U.S. seaports, there is a wide variation in the powers and duties exerted by local port authorities whose activities may vary with the functions performed, the size of the port, the number of functions to be performed, the size of the staff to be employed, and the scope of the port's legal jurisdiction. In some ports, practically all terminal facilities are owned and operated by railroads or other private interests and the local port authority performs only perfunctory administrative and regulatory functions. In the opposite extreme, practically all facilities are publicly owned and operated under the control of the port authority.

Local government agencies still appear to be the dominant form of port administration and own some 70 percent of the publicly owned port facilities in the United States. On the other hand, State government agencies own some 30 percent of the publicly owned port facilities. However, the greatest number of port facilities in the United States are privately owned and operated by profitmaking organizations. Among the private proprietorships there are a small number of private nonprofit organizations and cooperatives which own and operate only a very insignificant number of port terminal facilities. The nonmilitary agencies of the Federal Government make up the final class of proprietors and account for the ownership of only a small percentage of the total port facilities. A summary breakdown of the number and proportion of port facilities owned by the several classes of owners is tabulated, as follows:

Ownership of port facilities

	Number of terminals (estimate)	Percent of U.S. total (estimate)
Type of ownership:		
Private (profitmaking organizations)	1,359	64.1
Local government agencies	499	23.5
State government agencies	214	10.1
U.S. Government agencies (nonmilitary)	43	2.0
Private (nonprofitmaking organizations)	6	0.3
Total	2,121	100.0

(f) *Value of Facilities*

As of the end of 1965, the (then) current value of all categories of port terminal facilities and structures is estimated to be about $3.4 billion.

The probable original cost (new) of the entire capital plant was determined by working backward from present estimated value of all types of port terminal structures. The combined average age of all port terminal structures was estimated to be 24.6 years and thus 1941 became the base year for original or new cost. The construction cost index for December 1965, was converted to base year 1941, i.e., 1941 equals 100, and from the adjusted cost index the estimated original or new cost of facilities in 1941 was determined.

Three general values were estimated: (1) Cost new or original cost; (2) 1965 replacement cost; and (3) 1965 actual cash value, as follows:

Cost new (estimated)	$1,886,700,000
1965 replacement cost (estimated)	6,792,100,000
1965 actual cash value (estimated)	3,396,100,000

B. Costs and User Charges

1. Construction Costs and Operating Costs of Port Terminal Facilities

(a) *Typical Construction Costs*

Based on acceptable engineering cost estimates of various port facility structures, the range of current typical construction costs for different types of port terminal facilities are tabulated, as follows:

Type of terminal (single berth)	1965 average cost per linear foot of berthing (estimated)	1965 average total unit cost of construction (estimated)
General cargo facilities:		
General cargo (shedded)	$3,500	$2,500,000
General cargo and open (unshedded)	2,800	2,000,000
Specialized facilities:		
Bulk liquid (petrol and other)	1,400	1,000,000
Dry bulk (all types)	5,700	4,000,000
Container	2,800	2,000,000

(b) *Maintenance and Operation Expenses*

Maintenance and Renewals: Based on records spanning a 17-year period, January 1, 1946 to December 31, 1962, the following table shows the range of annual modernization and rehabilitation expenses

incurred by various ports in the United States. These expenditures include all additions, replacements, improvements, and restorative work to existing facilities which do not result in additional new berths.

Average annual modernization and rehabilitation expenses in selected ports of the United States by coastal region

[In thousands of dollars]

Coastal region	General cargo facilities (shedded and open)	Specialized facilities (dry, liquid bulk, and container)	Total annual expenses (all facilities)
Great Lakes	331	1,432	1,763
Atlantic coast	7,146	3,084	10,230
Gulf coast	1,827	1,284	3,111
Pacific coast (including Alaska and Hawaii)	3,035	889	3,924
Total	12,339	6,689	19,028

Maintenance and operating: The cost of maintenance in a sampling of representative ports of the United States is estimated to be about 37.5 percent of all operating costs. Direct operating expenses make up the principal part of all operating expenses, and most of the payroll expenses relate to direct operations. Operating expenses are estimated to be about 62.5 percent of total port expense.

2. USER CHARGES

(a) *Port Operating Revenues*

As a public agency, a port authority must depend upon its own resources and those of the State or local government unit which sponsors it. The port's own resources include its income and loans based on expected income and in some cases taxes which it may levy over an area designated as a special tax district.

Port management must seek sufficient revenues to sustain the operation of a successful port enterprise. The principal revenues obtained by a port are derived as a result of providing and performing certain normal functions such as maintenance of publicly owned marine terminal facilities, leasing of publicly owned facilities, dredging slips along publicly owned wharves, collection of port dues and charges, promotion of traffic through the port, construction and replacement of facilities, and similar functions. It is conceded that a port authority is entitled to levy charges which at least attempt to defray over a period of time the costs of performing any of these normal functions.

An earlier study which was made of the port revenues [1] of some 30 representative ports of the United States showed that the average percentage distribution of total income was as follows:

	Percent
Wharfage, dockage, tollage, etc	27.7
Other terminal services	35.5
Rentals and leases	24.7
Other operating means	12.1
Total	100.0

[1] In addition to these so-called port/terminal operating revenues, there are miscellaneous port dues and charges such as harbor dues, pilotage fees, towage charges, and quarantine dues which are not normally included under said operating revenues.

(b) *Adequacy of Port Operating Revenues*

Ratemaking has become a difficult and very important aspect of port management. The reward for efficient ratemaking in terms of attracting trade and yet producing a good level of revenue is very significant. There are limits to what can be done with port fees, and dues, such as harbor dues, etc., and, as stated, these revenues do not normally accrue to terminal owners and operators. In some ports more can be done in regard to special services such as fumigation, compressing, and elevation. Warehousing rates are by necessity related to warehouse rates for the community as a whole. Switching rates are subject to regulation by the State's public utility commission and the Interstate Commerce Commission. But much can be done with dockage, wharfage, terminal services, including service charges and rentals. Adequate charges are sometimes made difficult because of the competition of railroad-owned terminals and industrial terminals, who derive their principal revenue from other sources such as line hauls, sale of end products, etc.

Revenues derived by the port authority from the operation of its terminals and waterfront facilities are applied to the payment of the cost of operation and administration including interest on bonds or other evidences of indebtedness. Usually any balance in favor of the port authority is paid to the treasurer to be used for the purpose of providing a sinking fund or special reserve fund with which to pay at or before maturity all bonds and/or notes or other evidences of indebtedness. In some instances where port revenues are insufficient to pay the cost of operation, administration, special reserve fund requirements, interest on bonds, and similar costs of operation, a special local or State tax may be levied, subject to local or State limitations and regulations, on all taxable property within the territorial limits of the local port jurisdiction in an amount sufficient to meet the deficiency. There are very few ports where user charges exceed the sum of prorated operating and capital costs.

(c) *Financing Costs of Port Operations and Improvements*

Expenditures could be financed through increased harbor fees, local or State taxes, or through borrowing. It has become rather common practice to set up general port funds into which all revenues, taxes, and appropriations go and out of which capital and operating needs are met. Special reserve funds may be set up by a port. Many ports have (1) a leased wharf fund; (2) a harbor improvement bond fund; and (3) a harbor maintenance and development fund.

As a general statement, practically all public port authorities in the United States today are extended some form of local public aid. Such aid may be in the form of direct appropriations, general obligation bonds of the city or State, taxes levied in behalf of the port, and the assignment of actual or potential tax means as security for port bonds and other certificates of indebtedness. There is a growing trend toward the financing of general cargo facilities with revenue bond issues as against general obligation bonds. This has largely been made possible by the ability of the public body to pledge addi-

tionally the revenues from facilities originally built by general obligation bond issues which have been amortized.

A local public port body is in an enviable position to build a public terminal operated for all users on a tariff basis. In contrast, where construction is by private interests, lending institutions would require guaranteed income from the facility in the form of a long-term lease, which usually indicates a single user for a single purpose. Moreover, public bodies can borrow at lower interest costs because the interest income on their obligations is tax exempt.

Practically all new general cargo port terminal construction in the United States today is undertaken by local public authorities, whereas bulk and industrial and other specialized terminals are normally provided by private interests for their own, nonpublic, use. There is no general demand for any Federal financial assistance with respect to the latter facilities.

It is estimated that 6 percent of the costs of port facilities and structures are met out of general tax resources and bond borrowings of State and local government units. Informatively, 36 percent of such costs are met by the port revenues of said government units; 50 percent by private interests and the balance by State grants and Federal Government loans and grants.

C. Trend of Capital Outlays for Port Development

1. ANNUAL CAPITAL EXPENDITURES

Total port development expenditures for the Great Lakes and the three ocean coasts of the United States, including the States of Alaska and Hawaii, during the 17-year period January 1, 1946 through December 31, 1962, were $1,619,600,000. This reflects an increase of $400,249,000 or 33 percent over the $1,219,351,000 expended during the 14½-year period ending June 30, 1960.

The rate of capital expenditures for port development purposes has accelerated remarkably in the last 10 years. In comparison with the 10-year period immediately following the end of World War II, the overall yearly average expenditure has risen from $62.9 million to $95.4 million during the 1960's.

The regional pattern and emphasis of expenditures for port development have remained relatively constant, maintaining, for the most part, the historic relationships among port areas.

The annual rate of port development expenditures in the United States continues its overall upward trend, and ports are continuing to carry out a vigorous program of modernization and expansion. It should be noted too that announced plans for future development in almost every port area indicate that this program of construction and rehabilitation promises to continue for some time to come.

The following table gives a summary breakdown of port development expenditures by coastal region in the United States. Annual data are shown in the succeeding table.

Trend of capital outlays for port terminal facilities in the United States by coastal region Jan. 1, 1946 to Dec. 31, 1962

[In millions of dollars]

Coastal region	Number of new general cargo berths added		General cargo facilities (shedded and open)	Specialized facilities (dry, liquid bulk and container)	Total capital outlay (all facilities)
	Shedded	Open			
Great Lakes	40	16	65.7 [1] (3.9)	132.2 [1] (7.8)	197.9 [1] (11.7)
Atlantic coast	129	38	497.3 [1] (29.3)	266.6 [1] (15.7)	763.9 [1] (45.0)
Gulf coast	59	22	151.8 [1] (8.9)	142.6 [1] (8.4)	294.4 [1] (17.3)
Pacific coast (including Alaska and Hawaii)	99	21	249.7 [1] (14.7)	113.7 [1] (6.7)	363.4 [1] (21.4)
Total	327	97	964.5 [1] (56.8)	655.1 [1] (38.6)	1,619.6 [1] (95.4)

[1] Overall annual average capital outlay over 17-year period, Jan. 1, 1946, to Dec. 31, 1962.

Trend of capital outlays for port terminal facilities Jan. 1, 1946 to Dec. 31, 1962, in the United States

Total U.S. capital outlay for port development [1]			Average annual rate of capital outlay (millions of dollars)				
Years	Millions of dollars [2]	Percent gain	Years	Privately owned facilities (64 percent)	Publicly owned facilities (34 percent)	U.S. Government-owned facilities [3] (2 percent)	All facilities (100 percent)
1946–55	629.2		1946–55	49.3	21.4	1.2	62.9
1946–57	887.0	[4] 40.9	1956–57	82.4	43.8	2.8	129.0
1946–60	1,219.3	[5] 37.4	1958–60	85.1	45.2	2.6	132.9
1946–62	1,619.6	[6] 32.8	1960–62	102.5	54.4	3.2	160.1

[1] Includes selected ports of the 3 ocean coasts, Great Lakes, Alaska, and Hawaii.
[2] Accumulative.
[3] Excludes military facilities.
[4] Between 1955 and 1957.
[5] Between 1957 and 1960.
[6] Between 1960 and 1962.

2. DISTRIBUTION OF ANNUAL CAPITAL EXPENDITURES

The following table shows the proportions of capital outlays which are accounted for by the various types of ownership of port terminal facilities in the United States.

Proportions of overall annual average capital outlays accounted for by various types of ownership of port terminal facilities, Jan. 1, 1946 to Dec. 31, 1962

Type of ownership	Annual dollar amounts of average capital outlays (millions of dollars)	Percent distribution of average capital outlays (estimate)
Private (profitmaking organizations)	61.2	64.1
Local government agencies	22.4	23.5
State government agencies	9.6	10.1
U.S. Government agencies (nonmilitary)	1.9	2.0
Private (nonprofitmaking organizations)	.3	.3
Total	95.4	100.0

3. SOURCES OF FINANCING FOR CAPITAL EXPENDITURES

Based on percentage distribution, the following table shows the dollar amounts of capital expenditures proportioned among the various sources of financing for the construction of port terminal facilities.

Proportions of overall annual average capital outlays accounted for by various sources of financing for construction of port terminal facilities, Jan. 1, 1946, to Dec. 31, 1962

Sources of financing	Annual dollar amounts of average capital outlays (millions of dollars)	Percent distribution of average capital outlays (estimate)
Capital flotations	47.7	50
Port revenues	34.4	36
Tax exempt municipal bond market	4.8	5
Borrowing from Federal Government	2.9	3
Federal Government grant assistance	1.9	2
State grants-in-aid	1.9	2
Appropriations from tax resources	.9	1
Gifts, bequests, donations, fundraising	.9	1
Total	95.4	100

D. NEEDS AND PROSPECTIVE CAPITAL OUTLAYS FOR PORT DEVELOPMENT

1. CAPITAL REQUIREMENTS (1966–75)

The capital requirements for port terminal facilities during the decade 1966–75 are estimated to be $1,281.5 million.

The reason for such a large capital outlay during the next decade can be traced to the substantial numbers of antiquated terminals in the Nation's ports. Many are not adequate on a qualitative basis due to the current and future requirements imposed by technological developments in both sea and land transport. The long-awaited replacement of these outdated terminals is being given new impetus with the disclosure that the major shipping lines are in the need of specialized terminals to fill their needs, particularly with respect to the processing and handling of containers at an extremely rapid pace. The use of containers in the movement of ocean commerce will develop with intensity in the next decade. Today, a noteworthy general port facility building program is underway and several ports have unique long-range master plans to provide additional terminals to meet shipping needs as far in advance as 1980.

Encompassed in these programs are container, general cargo (break-bulk), liquid, and dry bulk, terminals of the most modern design. The container terminals and general cargo terminals are designed with long ship berths, wide aprons, large and more efficient transit sheds, cargo distribution buildings, and generous amounts of open storage space for flexibility of operation, truck and trailer park, and spacious accommodations for the various modes of connecting transportation.

(a) *Factors Upon Which Projection Is Based*

In approaching the means of estimating the projection of prospective capital outlay to meet the needs of the port and shipping industry during the decade 1966–75 it was necessary to construct some commerce projections in order to determine future needs.

The application of projected national indicators such as population growth, income, industrial growth, power consumption, production, natural resources, potential markets, and similar barometers were some of the factors considered in arriving at estimates of future trade. The projections were placed into categories of general cargo, dry bulk, and bulk liquid so as to match the types of marine terminal facilities to accommodate their transshipment.

Utilizing this forecast, calculations were then made to determine the port terminals needed to handle the projected tonnage of break-bulk general cargo, containers, petroleum, grain, coal, ore, and other miscellaneous types of commodities (bananas, chemicals, gypsum, cement, etc.). The number of terminals needed in the various commodity categories and the capital requirements per year are shown in the following table.

Capital requirements for port terminal facilities

[Dollars in millions]

	1966		1967		1968		1969		1970		1971		1972		1973		1974		1975		Total number and cost in 10-year period	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
3-OCEAN COASTS																						
General cargo terminals	8	20.2	8	20.6	8	21.2	8	21.9	8	22.5	8	23.2	8	23.8	8	24.6	8	25.3	8	26.1	80	229.2
Container terminals	4	8.0	4	8.2	4	8.5	4	8.7	4	8.8	4	9.0	4	9.3	4	9.7	4	9.8	4	10.2	40	90.2
Petroleums	5	5.0	5	5.2	5	5.3	5	5.5	5	5.6	5	5.8	5	6.0	5	6.1	5	6.3	5	6.5	50	57.3
Grain terminals	1	4.0	1	4.1	1	4.2	1	4.4	1	4.5	1	4.6	1	4.8	1	4.9	1	5.1	1	5.2	10	45.8
Coal terminals	1	4.0	1	4.1	1	4.2	1	4.4	1	4.5	1	4.6	1	4.8	1	4.9	1	5.1	1	5.2	10	45.8
Ore terminals	1	4.0	1	4.1	1	4.2	1	4.4	1	4.5	1	4.6	1	4.8	1	4.9	1	5.1	1	5.2	10	45.8
Other terminals	2	8.0	2	8.2	2	8.5	2	8.7	2	9.0	2	9.3	2	9.6	2	9.8	2	10.1	2	10.4	20	91.6
GREAT LAKES																						
General cargo terminals	2	5.0	2	5.2	2	5.3	2	5.5	2	5.6	2	5.7	2	6.0	2	6.2	2	6.3	2	6.5	20	57.3
Container terminals	2	4.0	2	4.1	2	4.2	2	4.4	2	4.4	2	4.5	2	4.7	2	4.8	2	4.9	2	5.1	20	45.1
Petroleum terminals	2	2.0	2	2.1	2	2.1	2	2.2	2	2.3	2	2.3	2	2.4	2	2.5	2	2.5	2	2.6	20	13.0
Grain terminals	3	12.0	3	12.4	3	12.7	3	13.1	3	13.5	3	13.9	3	14.3	3	14.8	3	15.2	3	15.7	30	137.6
Coal terminals	3	12.0	3	12.4	3	12.7	3	13.1	3	13.5	3	13.9	3	14.3	3	14.8	3	15.2	3	15.7	30	137.6
Ore terminals	3	12.0	2	12.4	3	12.7	3	13.1	3	13.5	3	13.9	3	14.3	3	14.8	3	15.2	3	15.7	30	137.6
Other terminals	3	12.0	3	12.4	3	12.7	3	13.1	3	13.5	3	13.9	3	14.3	3	14.8	3	15.2	3	15.7	30	137.6
Total terminals and cost per year	40	112.0	40	115.5	40	118.5	40	122.5	40	125.7	40	129.2	40	133.4	40	137.5	40	141.4	40	145.8	400	1,281.5

(b) *Estimated Capital Needs for Port Facilities*

The estimated capital needs per year during the decade 1966–75 are shown in the following table:

Year:	*Millions of dollars*	Year—Continued	*Millions of dollars*
1966	112.0	1971	129.2
1967	115.5	1972	133.4
1968	118.5	1973	137.5
1969	122.5	1974	141.1
1970	125.7	1975	145.8

(c) *Distribution of Capital Outlays for Port Facilities by Size of Port City*

The capital need for cities with populations of 50,000 or more is estimated to be $1,025.8 million; for cities and towns with populations of 2,500 to 49,999 is $226.1 million; and for towns with populations under 2,500 the capital need is estimated to be $29.6 million. A breakdown is shown in the following table.

Distribution of capital requirements for port terminal facility by size of port city (1966–75)

Port city population	Number of ports	Percent of total capital plant	Capital requirements (millions of dollars)
500,000 or more	15	46.9	600.5
100,000 to 499,999	27	23.1	297.1
50,000 to 99,999	19	10.1	128.2
Subtotal, 50,000 or more	61	80.1	1,025.8
10,000 to 49,999	45	13.9	178.5
2,500 to 9,999	23	3.7	47.6
Subtotal, 2,500 to 49,999	68	17.6	226.1
2,500 or less	39	2.3	29.6
Grand total	168	100.0	1,281.5

(d) *Distribution of Capital Outlays for Port Facilities by Form of Ownership*

The State governments or State agencies are expected to expend an estimated outlay of $129.4 million; the cities, counties, towns, special districts, public authorities, and other public bodies $301.2 million; and the proprietary or profitmaking organizations $821.4 million during the decade 1966–75. Details are indicated in the following table.

Proportions of estimated capital outlays accounted for by various types of ownership of port facilities (1966–75)

Type of ownership	Percent distribution of total capital outlay	Dollar amounts of total capital outlay (millions of dollars)
Private (profitmaking organizations)	64.1	821.4
Local government agencies	23.5	301.2
State government agencies	10.1	129.4
U.S. Government agencies (nonmilitary)	2.0	25.6
Private (nonprofitmaking organizations)	.3	3.9
Total	100.0	1,281.5

2. EXPECTED SOURCES OF FINANCING FOR ESTIMATED CAPITAL NEEDS

A significant proportion of the total capital requirements will be spent by State, bistate, city, county, or regional agencies responsible for port development. The public projects will be financed largely by port revenues, revenue bonds, or tax-supported bond issues, with some financing by direct tax levies, and with little Federal participation expected. The sources of financing for the $1,281.5 million may be as follows:

Proportions of estimated capital outlays accounted for by various sources of financing for port development (1966–75)

Sources of financing	Percent distribution of total capital outlay (estimated)	Dollar amounts of total capital outlay (millions of dollars)
Capital flotations	50	641.0
Port revenues	36	461.2
Tax exempt municipal bond market	5	64.1
Borrowing from Federal Government	3	38.4
Federal Government grant assistance	2	25.6
State grants-in-aid	2	25.6
Appropriations from tax resources	1	12.8
Gifts, bequests, donations, fundraising	1	12.8
Total	100	1,281.5

CHAPTER 16

Public Elementary and Secondary School Facilities*

A. NATURE AND COMPOSITION OF PUBLIC SCHOOLS

1. DESCRIPTION OF FACILITIES

(a) *Physical Characteristics*

Public school facilities are of various types ranging from one-room structures of wooden frame to massive steel-ribbed and masonry buildings. In the cities multistoried structures often touch the sidewalk and provide limited land area for a playground. In the suburbs the average facility occupies only a small proportion of the acreage available and ample space can be found for parking, grass, and several play fields.

TABLE 1.—*Number of acres in the median school site by organizational level for selected decades United States: 1965*

Completion date of original building	Elementary	Combined	Secondary
Before 1920	1	5	3
1940–49	4	10	10
1960–65	10	15	27
Median all sites	3	8	11

Source: George J. Collins, *National Inventory of School Facilities and Personnel, Spring 1962.* Washington, D.C., Department of Health, Education, and Welfare, Office of Education. 1963.

The structural characteristics of permanent school buildings and additions are shown in table 2 for selected periods of construction. The characteristics of school construction reflect the gradual transition from the predominant type of buildings constructed "before 1920" to the more modern look of a slab-on-grade, one-story, masonry outline filled with glass, and more fire resistive than structures of earlier periods. The urban and nonurban school structures were different before 1920 and in the sixties also reflect notable differences. Before 1920, the typical urban school was multistory, masonry, with wooden interiors. In the sixties, it is still multistory, masonry, but more fire resistive. The nonurban schools before 1920, were single story, wooden, and combustible. In the sixties with the great growth in the suburbs, the elementary schools are mainly single story, but utilize steel framing with masonry walls and are more fire resistive. Secondary schools in the suburbs are multistory and otherwise similar to the elementary structures.

(b) *Services Rendered*

School facilities must, above all other considerations, serve the main objective of the educational program—*learning.* Learning in public

*This chapter was prepared by Dr. George J. Collins, National Center for Educational Statistics, Office of Education, Department of Health, Education, and Welfare, with minor editing by committee staff.

y and secondary education is attained by children from as
4 years old to as old as 20. Generally most of the population
ages of 6 to 18 years old is attending public and nonpublic
y and secondary school facilities. In 1947, the total enroll-
in public schools was about 25 million pupils, and by 1965 it
42 million. An additional 6 million pupils in 1965 attended
schools.

Number and percent of permanent buildings and additions with selected structural characteristics for the United States: 1962

Structural characteristic	Total		Before 1920		1920 to 1939		1940 to 1959		After 1959	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
nanent build- ltions	170,726	100.0	29,683	17.4	44,438	26.0	75,233	44.1	20,551	12.0
	50,878	29.8	17,936	10.5	20,132	11.8	10,880	6.4	1,824	1.1
	113,995	66.8	12,246	7.2	23,391	13.7	61,039	35.8	16,811	9.8
vall	28,275	16.6	10,431	6.1	8,995	5.3	7,603	4.5	1,052	.6
le wall [2]	123,732	72.5	18,429	10.8	32,330	18.9	56,388	33.0	16,295	9.5
[3]	57,687	33.8	16,631	9.7	18,052	10.6	19,290	11.3	3,395	2.0
	42,656	25.0	2,256	1.3	7,726	4.5	23,871	14.0	8,690	5.1
ng [3]	51,711	30.3	9,210	5.4	13,469	7.9	23,237	13.6	5,693	3.3
	76,122	44.6	4,024	2.4	13,438	7.9	43,322	25.4	15,133	8.9
	40,023	23.4	13,522	7.9	12,213	7.2	12,197	7.1	1,877	1.1

isements.
me, brick, blocks, or tile.
presents the vertical supporting members of the building.

ge J. Collins, *National Inventory of School Facilities and Personnel, Spring 1962*. Washing-
artment of Health, Education, and Welfare, Office of Education. 1963.

3.—*Percent of population 3 to 19 years old enrolled in school for the United States: 1947 and 1965*

	3	4	5	6	7 to 9	10 to 13	10 to 15	16 to 17	18 to 19
			53.4	96.4	98.4	98.6	91.6	67.6	24.3
	4.9	16.1	70.1	98.7	99.3	99.4	98.9	87.4	46.3

U.S. Department of Commerce, Bureau of the Census, *Current Population Reports* P-20, No
and U.S. Department of Health, Education, and Welfare, Office of Education, Samuel Schloss
-, 4-, and 5-Year-Olds in Nursery Schools and Kindergartens, 1966.

Standards of Performance

Standards of performance are not available for education on a per basis. The ratio of pupils to instructional rooms provides one used measure of the adequacy of school facilities. School consist of regular instructional rooms, special instructional and general-use spaces. The regular instructional rooms are in elementary schools and in secondary schools for instruction the subjects not requiring special equipment.

The number of pupils attempting to learn in a room provides one to measure the current standard of performance. This is the room ratio.

The median number of pupils to a room has been relatively con- elementary rooms but secondary rooms are becoming more (See table 4.) Although there is widespread agreement small classes provide more opportunities for learning, there is single acceptable standard. Among the important conditions ich effective learning takes place are: readiness of the pupil, n, level of maturity, socioeconomic background, nature of

the subject matter, experience and ability of the teacher, n instruction, and others. Judgment of teachers and principals upon experience with the general level of pupil ability, the bility for supervision, and the demands of society, frequently 25 pupils to an instructional group. In team teaching situati classes are much larger and others much smaller, depending upon specific objectives of the instruction. In general, however, area needed for conventional teaching and team teaching is when a given level of quality space and enrollment size are constant.

TABLE 4.—*Median number of pupils in a room for the United States*

	Elementary
1961–62 [1]	27.6
1964–65 [2]	27.4
Teachers' preference	25.0

[1] George J. Collins, "*National Inventory of School Facilities and Personnel.*"
[2] George J. Collins, and William L. Stormer, "*Conditions of Public School Plants,*" U.S. Health, Education, and Welfare, Office of Education, Washington, D.C., 1965.

The medians shown in table 4 do not reflect the wide disp pupil accommodation in rooms. These disparities are reflected table 5.

TABLE 5.—*Percent of pupils in selected number of pupils to rooms, Spring 1962*

Number of pupils to rooms:	*Percent of all publ*
Less than 20	
20 to 29	
30 to 39	
40 or more	

For a nation with 42.1 million pupils in public schools and million instructional rooms [1] in use and with half the pupils exceeding 27 pupils, it would take an additional 180,000 ins rooms to meet the level of performance preferred by teachers principals (i.e., 25 pupils to a room).

Table 6 shows the number of additional rooms needed to overcrowding using five different measures for determining crowding.

TABLE 6.—*Number of additional instructional rooms needed to eliminate ing as determined by varying measures of pupil accommodation for the States: 1965*

	Measure of pupil accommodation
Level I:	
Elementary	25 pupils to a room
Secondary	20 pupils to a room
Level II:	
Elementary	25 pupils to a room
Secondary	do
Level III (median):	
Elementary	27.4 pupils to a room
Secondary	27.5 pupils to a room
Level IV:	
Elementary	30 pupils to a room
Secondary	do
Local appraisal:	
Elementary	Locally determined
Secondary	do

[1] Instructional rooms are designed or remodeled for class instruction and include all regul laboratories, and shops.

Another standard of performance is the number of special instruc- rooms needed to accommodate the pupil population. The these special instructional rooms in schools to eliminate over- schools, to replace inadequate facilities, and to provide space am improvements are shown in table 7. The special instruc- oms needed for overcrowding are part of the total number of onal rooms needed to eliminate overcrowding. (See table 6.) ial instructional rooms needed to replace inadequate rooms [2] also included in the rooms reported as inadequate in table 8. improvements are an additional need from the demand of o improve education.

7.—*Number of special instructional rooms needed in public schools for the United States: 1965*

	Total	Overcrowding	Inadequate	Program improvements	Annual construction rate
Total special instructional rooms	87,000	37,000	30,500	19,500	6,950
tory	20,500	7,500	8,000	5,000	1,200
oratory	9,000	4,000	3,000	2,000	550
ps	14,000	6,500	4,500	3,000	900
s	12,000	5,000	4,000	3,000	500
	19,500	8,500	6,000	5,000	1,200
	6,500	2,500	2,500	1,500	800
	5,500	3,000	2,500	(1)	1,800

[1] Does not include needs for Elementary-Secondary Act of 1965.

NOTE.—The above estimates are based mainly on information from school officials in the 1964 survey of s. Major findings from this survey have been reported in the previously referenced publica- *Construction of Public School Plants, 1964-65.*

General-use spaces for libraries, auditoriums, gymnasiums, and are also important instructional spaces needed for most Schools with only one or two rooms can most often do with- these special facilities, but the average elementary school and the secondary school require these special spaces. The absence spaces is reflected in table 8.

8.—*Estimated number and percent of pupils without libraries, auditoriums, gymnasiums, and cafeterias, for the United States, 1965*

General-use facility	Number	Percent
ies	11,800,000	28
oriums	8,000,000	19
asiums	13,000,000	31
rias	9,300,000	22

NOTE.—Based on *National Inventory of School Facilities and Personnel, Spring 1962-table 5.*

Table 9 shows the number of general-use spaces needed to eliminate ding, to replace inadequate facilities, and to provide program ents. Many of the inadequate general-use units are needed replace combustible structures. There are 5,500 libraries, 2,700 ms, 6,200 cafeterias and 2,000 gymnasiums with combustible gs.

[2] rooms are reported for conditions of educational obsolescence, fire and safety, health and tural, or population movement.

TABLE 9.—*Number of general-use facilities needed to eliminate overcrowding, replace inadequate facilities and to improve programs for the United St*

	Needed facilities
Total, general-use	82,500
Libraries	24,100
Cafeterias	19,500
Gyms	21,000
Auditoriums, little theaters	17,900

NOTE.—This table shows current needs for special facilities and general-use areas. Cafete auditorium needs are based on accommodating 200 pupils at the elementary level, 400 at th The need could be reduced if areas were used for dual purposes. Figures in the first column sho backlog, second column is present annual construction rate.

(d) *Structural Standards of Performance*

Since 1956 the Office of Education has collected and publis evaluations of classrooms, but the significance of these data occasionally questioned, because the criteria for evaluation from place to place. In consequence, the survey, *Condition of School Plants 1964–65*,[1] included a number of definitive concerning important educational, fire safety, health, struct environmental conditions of buildings. Data obtained in res these questions are summarized in table 10. More detail is appendix table A, which provides comprehensive State- information on structural condition and educational adequacy classrooms as reported by local school officials.

As table 10 shows, 88 percent of all classrooms are c educationally adequate, and the majority of these are in which are structurally sound and in good repair. A su minority of these adequate rooms, however, are in deteriorati ings—21 percent of all rooms in buildings which need repairs, and percent in buildings requiring modernization or major rehab

TABLE 10.—*Number of rooms used for instructional purposes, by various of adequacy of the buildings, and plans for improving the situation for the States, 1965*

	Number	Percent
Total number of rooms [1]	1,550,000	
Total adequate rooms	1,361,300	
Adequate rooms in building requiring:		
No change	803,700	
Minor repairs	325,400	
Modernization or rehabilitation	233,200	
Total inadequate rooms	182,900	
Inadequate rooms in building requiring:		
No change	9,800	
Minor repairs	12,300	
Modernization or rehabilitation	29,800	
Rooms in buildings that should be abandoned	103,300	
Makeshift spaces not counted in above	27,700	

[1] Because of rounding, items do not add to totals.

The remaining classrooms, comprising 13 percent of the should be replaced, either because they are inadequate for ed

[1] George J. Collins and William L. Stormer, *Condition of Public School Plants 1964–65*. D.C., Department of Health, Education, and Welfare, Office of Education. 1965.

or because they are in structures which should be abandoned. ion on these rooms is summarized in the lower part of table

Table 11 presents information on the numbers of students adversely by certain definitive shortcomings in public school buildings. category is accompanied by an estimate of the number of ns required to overcome the deficiency, but it should be noted se estimates are not additive, because the categories are not exclusive.

TABLE 11.—*Classroom conditions in the public schools, 1965* [1]

Problem	Number of pupils adversely affected	Number of classrooms needed
ed classrooms (30 or more pupils per room)	12,645,000	57,000
ed classrooms (over national average, 27 pupils per room)	19,187,000	107,000
al service	64,000	2,000
piped into building	185,000	9,000
ng	2,036,000	84,000
e World War I	5,131,000	200,000
, makeshift or offsite classrooms	2,135,000	78,000
structural deterioration	1,308,000	52,000
Using outdoor privies	518,000	19,000

[1] 50 States, District of Columbia, plus 4 outlying areas.

NOTE.—The above figures are related to 1964–65 enrollments. They do not reflect the need for additional accommodate new public school enrollments which will increase from 42,800,000 in 1965 to 970.

2. EXISTING CAPITAL PLANT IN THE UNITED STATES

(a) By mid-1965, there were 1,550,000 classrooms in public schools. addition to the classrooms, the general-use facilities numbered ately 213,800.

—*Estimated number of general use facilities for the United States 1965*

	Number
General facilities	213,800
l school libraries	52,300
ıs	24,100
or lunchrooms	46,000
ns	27,700
ɔn facilities	42,500
Auditoriums	(40,200)
Cafeterias	(21,100)
Gymnasiums	(30,500)
ipurpose rooms	21,200
its with no general facilities	16,000

d on national inventory of school facilities and personnel, 1962, table 18.

Distribution of Facilities by State

The distribution of school plants, buildings, rooms and pupils the States and outlying areas is reported in table 13.

Distribution by Population Size

The Office of Statistical Standards of the Bureau of the Budget has 219 standard metropolitan statistical areas (SMSA's). An a county or a group of contiguous counties which contain at one city of 50,000 or more inhabitants, or "twin" cities with population of at least 50,000.

TABLE 13.—*Number of school plants, buildings, rooms, and pupils in urban, urban fringe, and areas outside SMSA's, by State for the United States, 1964–65*

State	Urban schools				Urban fringe schools				Areas outside SMSA schools			
	Plants	Buildings	Rooms	Pupils	Plants	Buildings	Rooms	Pupils	Plants	Buildings	Rooms	Pupils
Alabama	295	636	6,802	208,707	298	675	5,389	141,422	1,223	2,267	15,720	395,693
Alaska									189	259	1,850	43,057
Arizona	86	188	2,688	75,561	242	581	6,718	169,026	274	550	4,353	108,711
Arkansas	64	97	1,318	31,993	146	234	2,564	67,460	700	1,634	11,105	258,681
California	1,616	5,266	40,712	1,330,413	2,990	9,564	67,157	1,938,704	1,076	3,642	21,954	502,431
Colorado	190	308	4,698	146,899	350	641	6,301	162,619	542	895	7,104	149,489
Connecticut	207	340	5,080	131,154	718	1,171	15,273	371,719	22	50	589	12,792
Delaware	21	21	663	15,383	61	133	1,928	47,497	79	140	1,483	36,587
District of Columbia	171	303	4,890	137,302								
Florida	840	2,010	23,220	670,961	19	56	501	14,365	751	1,754	15,528	396,479
Georgia	362	725	8,894	267,343	268	783	6,690	178,162	1,301	2,131	22,298	586,938
Hawaii	116	288	4,157	119,027					79	148	1,600	35,644
Idaho	37	58	701	19,500	1	6	35	368	399	649	5,990	137,564
Illinois	718	1,126	21,634	661,525	1,701	3,500	30,601	787,807	1,845	3,154	23,861	504,358
Indiana	344	768	9,968	288,686	532	1,031	9,019	239,482	1,113	2,033	20,052	482,032
Iowa	202	347	4,826	127,260	218	318	2,923	75,495	1,452	2,348	20,723	446,341
Kansas	188	409	4,044	113,503	195	462	4,018	99,654	1,769	2,550	17,439	23,812
Kentucky	91	156	2,319	62,384	169	314	4,290	113,149	1,681	2,442	16,833	430,775
Louisiana	335	811	9,143	237,349	218	498	4,865	129,248	918	2,151	18,076	403,317
Maine	44	47	600	16,960	142	233	1,474	35,490	734	945	6,199	150,444
Maryland	210	343	6,275	185,916	427	924	11,075	300,310	495	807	8,280	232,551
Massachusetts	513	632	9,981	253,666	1,332	1,855	24,986	607,957	86	121	1,314	30,807
Michigan	728	1,158	16,233	522,815	1,573	3,092	30,548	820,909	1,596	2,407	17,659	457,287
Minnesota	215	377	4,438	126,110	405	610	10,639	267,968	1,640	2,606	17,873	392,571
Mississippi	38	96	1,310	32,509	33	80	656	21,062	918	1,914	18,726	515,669

Missouri	297	486	6,919	202,271	479	1,005	9,916	245,938	1,306	2,460	17,141	367,600
Montana	46	72	1,088	29,171	46	84	394	6,350	957	1,284	7,087	140,666
Nebraska	153	275	2,920	88,936	97	174	1,429	29,404	2,254	2,723	12,889	228,716
Nevada	102	180	2,409	68,940					93	163	1,101	20,365
New Hampshire	23	35	458	12,932	169	326	2,309	55,758	215	329	2,391	55,333
New Jersey	223	288	7,136	186,556	1,218	2,156	28,377	690,489	616	935	10,308	286,335
New Mexico	70	214	2,260	59,500					540	1,004	8,039	182,115
New York	1,264	1,791	49,027	1,409,318	1,750	2,897	45,762	1,201,883	924	1,945	23,297	530,679
North Carolina	213	526	5,473	148,006	197	537	4,470	120,855	1,679	3,934	35,104	880,645
North Dakota	15	22	390	10,005	31	51	318	5,008	790	1,069	6,635	136,544
Ohio	737	1,197	22,902	636,154	1,445	3,253	35,857	940,200	1,467	2,503	24,286	606,648
Oklahoma	215	557	5,489	152,699	287	681	4,434	105,674	1,335	2,562	15,781	310,678
Oregon	145	330	3,660	95,419	257	640	5,075	114,855	773	1,504	10,120	224,446
Pennsylvania	627	930	16,487	473,704	2,372	3,506	42,561	1,092,712	1,432	1,912	20,241	533,818
Rhode Island	61	70	1,343	33,568	282	387	4,610	118,263				
South Carolina	140	229	3,176	88,060	197	450	4,369	123,234	844	1,470	15,606	415,448
South Dakota	23	37	494	14,576	43	49	204	4,083	1,795	2,158	7,809	147,115
Tennessee	238	425	6,839	184,494	364	758	7,125	194,175	1,503	2,591	17,425	448,903
Texas	1,118	2,179	30,885	848,444	1,060	2,226	23,400	552,493	1,903	4,303	37,196	764,315
Utah	92	186	2,467	65,126	186	376	4,258	128,205	262	443	3,465	75,496
Vermont									483	612	3,723	81,266
Virginia	285	449	7,160	197,128	350	662	7,913	214,385	1,169	2,132	19,196	513,420
Washington	263	624	6,179	175,579	471	1,060	10,411	257,605	736	1,466	12,403	281,928
West Virginia	243	413	3,380	90,470	113	209	1,130	31,240	1,451	2,162	12,513	316,593
Wisconsin	207	346	5,492	161,440	518	1,025	8,429	209,164	1,421	2,432	18,533	436,393
Wyoming									387	604	4,517	89,555
Canal Zone									19	40	504	12,532
Guam									17	18	407	11,782
Puerto Rico									1,782	3,851	12,843	557,107
American Samoa									49	49	224	7,020
Total	14,453	28,396	388,651	11,215,445	23,988	49,296	500,423	13,031,867	49,111	86,278	657,419	15,697,512
Percent of totals	16.5	17.3	25.1	28.1	27.4	30.1	32.4	32.6	56.1	52.6	42.5	39.3

NOTE.—Item responses do not add to exact totals because of rounding and the use of separate computer for State and National totals.

The report in table 13 separates the data into:

(1) Urban or central cities—that is, Detroit, Pontiac, and I within the SMSA;

(2) Urban fringe the remaining schools within the SMSA's, and

(3) The areas outside the SMSA's.

The separation between urban and urban fringe areas is of interest to public education, because it reveals that crowding of is greatest in urban centers. This is illustrated by the ta below.

TABLE 14.—*Number and percent of pupils in rooms with 30 or more pupils urban, urban fringe, and areas outside SMSA's, 1965*

Area	Pupils	Percent
Urban	4,300,000	
Urban fringe	2,900,000	
Outside SMSA's	3,200,000	

The approximate distribution of pupils and rooms among six classifications of population is a further refinement of the data in table 13.

TABLE 15.—*Estimated number of rooms by population size of city for the States, and outlying areas, 1964–65*

	Rooms
Total	—
Cities with population of—	
500,000 or more	
100,000 to 499,999	
50,000 to 99,999	
10,000 to 49,999	
2,500 to 9,999	
Under 2,500	

(d) An analysis of the structural characteristics of the 93,0(school facilities surveyed in the *National Inventory of School I and Personnel: Spring 1962* reveals that generally three periods construction are significant—before 1920, 1920–40, and after The investment in public school facilities is relatively new. than one-half of the schoolrooms were constructed since World II. Data are summarized in table 16.

TABLE 16.—*Estimated number and percent of instructional rooms in buildings by date of completion for the United States, spring 1965*

	Number	Percent
Data of completion: Total [1]	1,550,000	
Before 1920	214,000	
1920 to 1929	242,000	
1930 to 1939	161,000	
1940 to 1949	103,000	
1950 to 1959	513,000	
1960 to 1965	317,000	

[1] Because of rounding items may not add to total.

NOTE.—Based on *National Inventory of School Facilities and Personnel, 1962, table 8.*

Ownership

Public school facilities are legally owned by the State and held in by public school districts created by the State educational In an inventory of 93,000 public schools conducted in school officials reported 98.5 percent of the schools as publicly This includes schools owned by public authorities and leased schools. The remainder (1.5 percent) of the schools are not y public school districts or authorities, but are used as in- al facilities.

Estimated Current Value

The estimated current value of public school facilities is $58 billion, the replacement value at current costs would be $80 billion.

B. Costs and User Charges

1. CONSTRUCTION COSTS AND OPERATING COSTS

(*a*) During 1965, based on an analysis of projects reported in *Management*, construction costs per classroom ranged from to $135,000. There is substantial variation among States, both climatic differences, which are related to type of ion, and other differences, related to wage differentials and factors. Within States, costs vary among urban, suburban, rural communities; they also reflect factors such as the number type of classrooms in a project, structural characteristics, equip- and functional qualities, such as air conditioning, thermal and wall or floor coverings. National average data are zed in table 17. Averages for each State are given in ap- ble B.

17.—*Number of projects, rooms, and cost per classroom and per pupil for the United States, 1964*

Grade level	Number of projects	Number of rooms	Cost per classroom	Cost per pupil
New	1,158	20,513	31,600	1,178
Additions	1,517	8,970	32,400	1,100
New	859	22,190	47,600	1,811
Additions	1,417	10,353	48,800	1,911
All construction	4,951	62,026	40,300	1,505

NOTE.—Estimates are based on reports of project costs by individual school districts. They are intended sive; that is, to include land, site development, architects fees, construction, and initial equip- However, variations in reporting practices and other factors are known to result in omission of amounts, especially with respect to land and equipment.

Source: *School Management* "Current Trends in School Facilities," July 1965, p. 111.

(*b*) For the 1965–66 school year the budgeted maintenance ex- s for the United States were $610 million. The average nce expenditure per pupil was $15. Maintenance for includes salaries and expenditures for keeping grounds, , and equipment in a reasonable condition of efficiency through repairs or replacement of property.

The budgeted expenditures for operations were $1.8 billion the 1965–66 school year. The average operating cost per p about $43 per pupil. Operating costs cover activities c with keeping the physical plant open and ready for use. The cleaning, heating, lighting, and care of grounds, but do not repairs or replacement of facilities or equipment.

It might be supposed that larger schools could be operated efficiently and that per pupil costs for maintenance and o would decline as the size of the school plant increased. Instead, appears that the use of part-time employees and the practice contracting for services largely equalize per pupil expenditures these purposes among schools of varying size. There is, however, substantial relationship between total educational expenditures expenditures budgeted for maintenance and operation. Data marized in table 18 provide evidence of this relationship an large variations which are not apparent from averages.

TABLE 18.—*Variation in budgeted expenditures for maintenance and 1965–66*

Total district expenditure per pupil	Expenditure p	
	Maintenance	Operation
$200 or less	$7.84	
$201 to $250	9.96	
$251 to $300	13.28	
$301 to $350	15.68	
$351 to $400	19.71	
$401 to $450	22.71	
$451 to $500	23.85	
$501 or more	37.47	

2. USER CHARGES

(*a*) Funds for the construction of facilities are obtained fr (20 percent), local (72 percent), local authorities (7 percent), Federal taxes (1 percent). Current educational expenses, i those for maintenance and operation, are obtained from tax collected by State (39 percent), local (57 percent), and Federal percent). Pupils and their parents do not pay user charges but subject to the same general taxes as the general population. public authorities purchase school facilities, local school usually pay fees for lease of the building equal to the payments bonded indebtedness incurred by the public authority to c the school. When the bonds are paid the school districts are the school.

(*b*) *Extent user charges cover expenses.*—Pupils pay no direct that cover annual debt services or operations and mai expenses. Rental fees paid by community groups seldom

than the cost of utilities, cleaning, and custodial service; and often not even these three essentials.

(c) The cost of facilities is generally obtained from general obliga- bonds. In the following section a breakdown by source of 'll be reported.

C. Trend of Capital Outlay

1. 1946–65

During the 20-year period, fiscal 1946 through fiscal 1965, the tion of elementary and secondary school facilities has multi- many times; $111 million was spent in 1946 and $3.5 billion spent in 1965. There has been constant construction to meet needs of increased enrollment and replacement of obsolete fa- The increases in construction were most rapid immediately the war and as the postwar babies entered school in the early 1950's. Since 1956 the number of classrooms constructed each year ranged between 65,000 to 72,000 with the 10-year average being Some of the fluctuation in the rooms constructed and ex- es is caused by the construction of large secondary schools take more than 1 year to complete. Consequently the rooms usually reported in the year of completion, not necessarily the when the debts or expenditures are incurred.

2. Proportion of Annual Outlays

All construction reported was for local school districts. A very ıction of 1 percent were Federal schools.

3. Source of Financing Capital Outlays

Most of the financing (about 80 percent) during the period has been local school districts (see table 18). Most of this has been by sale of bonds. During the later years of the 1940's the States to recognize the financing problems and made some significant tions in the area of financing school construction. It must noted that nearly half the State contributions have been in the of loans or advances, with the burden of repayment still on the school district. School building authorities have accounted ly $200 million a year of public elementary and secondary construction. Approximately another $200 million a year coming from current taxes and accumulative building funds. The of gifts and private construction appear to be insignificant the total picture; however, they undoubtedly may be very signifi- to the individual school districts involved.

TABLE 19.—*Capital outlay and tax-exempt bonds sold for public elem secondary school facilities for the United States: 1946–66*

[Dollar amounts in millions]

Fiscal year ending June 30	Classroom units constructed	Expenditures	Expenditure by source				
			State	Public authority	Local school district	Federal grant Public Law 815	
Totals 1946–65	1,089,674	$44,794	$5,421	$2,956	$35,373	$991	
1946	(3,900)	111	(*)	(*)	(110)		302
1947	(7,000)	205	(*)	(*)	(200)		395
1948	(13,500)	412	(*)	(*)	(400)		476
1949	(21,000)	664	(*)	(*)	(650)		370
1950	(30,900)	1,014	43	(*)	(950)		854
1951	(38,900)	1,316	124	21	1,167	4	986
1952	(44,600)	1,563	194	66	1,260	43	957
1953	(55,100)	1,995	208	218	1,451	118	1,451
1954	(58,800)	2,200	180	204	1,711	105	1,667
1955	60,005	2,310	163	130	1,896	121	1,634
1956	63,283	2,607	196	211	2,111	89	1,804
1957	68,660	2,982	247	334	2,334	67	1,870
1958	72,070	3,062	327	242	2,424	69	
1959	69,453	2,539	324	(200)	1,941	74	
1960	69,400	2,823	370	161	2,226	66	
1961	72,214	2,864	(370)	(120)	2,315	59	2,357
1962	72,089	2,987	372	125	2,448	42	2,568
1963	65,300	2,700	(372)	240	2,035	53	2,274
1964	69,300	3,116	526	177	2,391	22	2,569
1965	(65,200)	(3,524)	(705)	(257)	(2,533)	29	2,823
1966	(69,000)	(3,800)	(700)	(250)	(2,820)	(30)	

NOTES

1. Includes only schools operated by local school districts.
2. Items are taken from various reports and publications in the Office of Education.
3. Items in parentheses are estimates.
4. Items not available are indicated by an asterisk.

D. NEEDS AND PROSPECTIVE CAPITAL OUTLAYS

(*a*) Capital outlay requirements for public elementary and s schools during the decade 1966–75 reflect three components:

(1) Replacement of dilapidated and obsolete facilities and tion of overcrowded classrooms.

(2) Accommodation of new enrollment, which is expected to by about 6 million students during the decade.

(3) Provision of arrangements to offer innovative services plementary programs which will broaden and deepen the range educational experiences available to all and to insure that feasible pupils from all races and walks of life attend school

Although there is no universally accepted standard of adeq school facilities, the first two of these components can be expr terms of numbers of classrooms required. These should insure, at minimum, that the most seriously outmoded and unsafe school ings are replaced and that present and future pupils can be ac dated without serious overcrowding. With a rapidly m population, the total elimination of local—and temporar crowding is probably not feasible. In general however, it is a for purposes of these estimates, that no significant proportion of pupil population should be housed in facilities more crowded the present median, which is between 27 and 28 pupils per The average accommodation will, of course, be somewhat lower.

It is more difficult to estimate, in terms such as classrooms or square
the facilities needed to insure a better balanced and richer
ıal program, and the opening of more equal opportunities
vantaged children. In some cases, much can be accomplished
by using more carefully selected—and frequently more expen-
es for new schools. In other cases, progress may be sought
the development of a network of supplementary education
perhaps accompanied by changes in the attendance areas of
served by those centers. In many situations, however,
y in the large cities, the achievement of educational goals
ıire more substantial departures from traditional patterns of
organization. In many instances it will probably require
ɔn of large amounts of city land and development of educa-
parks—a solution now being seriously studied by several cities.
-stimates of required expenditure are difficult because solutions
vary so greatly from community to community. It is known,
that only large outlays will provide satisfactory conditions
most situations. Available evidence tends to indicate that the
s included here are definitely conservative.

Capital outlay requirements for the decade are estimated as shown

	Millions
ent of outmoded and unsafe facilities and reduction of overcrowding (400,000 classrooms)	$20.6
lation of new enrollment, including an allowance for migration (350,000 rooms)	16.2
ent of education programs and extension of opportunities for disadvantaged pupils	5.0
Total	41.8

In the above summary, facility needs have been translated into dollditures, by assuming an average cost of $49,000 per classroom.
ɜ necessary to allow for a higher cost:

(i) If there is further increase in construction costs beyond the
te of about 3 percent per year; or

(ii) If the construction of a substantial proportion of the needed
must be postponed to the latter part of the decade. For
easons, including the long planning time required for effective
ation of urban systems, it seems likely that some postpone-
will occur, but no precise year-by-year estimates of future
building can be made.

Distribution of Capital Outlays by Size of Community

Only the roughest estimates of this distribution are possible. On
and, the urban fringe areas are expected to grow most rapidly.
the other hand, needs for replacement of facilities are generally
in the central cities and, to a lesser extent, in communities
of standard metropolitan statistical areas. In fact, it appears
ı of these three sectors should account for about one-third of
ɔl building activity during the decade.

Spending Agencies for Capital Outlays

The overwhelming majority of projected capital outlays will be
l by cities, counties, towns, and other local districts, responsi-
for operation of public schools. A small proportion—perhaps as
as 6 percent—will be expended by school building authorities.

APPENDIX TABLE A

U.S. Government Office of Health, Education, and Welfare, 1964 survey of school plants—Table 1; inflated counts, February 1965—Rooms used for instructional purposes by various degrees of adequacy of building and/or room by plans for improving the building situation, and additional rooms needed to reduce overcrowding

	Total number of rooms in use		Inadequate rooms designed for instruction in buildings requiring—								Makeshift rooms used for instruction		Adequate rooms designed for instruction in buildings requiring					
			No changes		Minor repairs		Modernization or rehabilitation		That should be abandoned				No changes		Minor repairs		Modernization or rehabilitation	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama	28,039	1.81	408	1.45	316	1.13	1,006	3.59	4,284	15.28	699	2.49	11,686	41.68	5,927	21.14	3,714	13.24
Alaska	1,850	.12	5	.26	8	.42	52	2.81	219	11.84	55	2.95	1,086	58.68	291	15.74	135	7.30
Arizona	13,695	.88	8	.06	38	.27	188	1.38	816	5.96	260	1.90	9,093	66.40	1,557	11.37	1,735	12.67
Arkansas	15,000	.97	228	1.52	118	.79	673	4.49	1,753	11.69	296	1.97	5,413	36.09	2,909	19.40	3,610	24.06
California	130,606	8.43	418	.32	698	.53	2,228	1.71	6,743	5.16	1,734	1.33	92,910	71.14	14,721	11.27	11,155	8.54
Colorado	18,118	1.17	87	.48	92	.51	329	1.82	1,076	5.94	375	2.07	11,585	63.94	2,468	13.62	2,106	11.62
Connecticut	20,982	1.35	75	.36	62	.30	214	1.02	1,059	5.04	477	2.28	11,706	55.79	4,267	20.34	3,121	14.87
Delaware	4,111	.27	58	1.40	27	.64	101	2.45	0	0	119	2.90	1,867	45.42	847	20.60	1,093	26.59
District of Columbia	4,891	.32	8	.16	16	.32	36	.73	417	8.53	408	8.35	1,524	31.17	1,194	24.42	1,287	26.33
Florida	39,309	2.54	211	.54	569	1.45	992	2.52	2,574	6.55	1,090	2.77	19,006	48.35	9,625	24.49	5,240	13.33
Georgia	37,207	2.40	234	.63	128	.34	574	1.54	2,539	6.82	1,006	2.70	18,495	49.71	9,102	24.46	5,128	13.78
Hawaii	5,799	.37	11	.19	24	.41	195	3.36	1,036	17.87	34	.59	1,924	33.18	1,318	22.72	1,256	21.66
Idaho	6,842	.44	89	1.31	114	1.67	206	3.01	867	12.68	149	2.18	2,503	36.59	1,650	24.12	1,262	18.45
Illinois	75,979	4.90	674	.89	471	.62	735	.97	3,448	4.54	1,442	1.90	39,099	51.46	17,667	23.25	12,444	16.38
Indiana	40,356	2.60	263	.65	392	.97	606	1.50	3,915	9.70	626	1.55	19,234	47.66	9,172	22.73	6,147	15.23
Iowa	28,468	1.84	274	.96	494	1.73	456	1.60	1,983	6.97	906	3.18	14,200	49.88	6,347	22.29	3,808	13.38
Kansas	25,118	1.62	445	1.77	351	1.40	266	1.06	1,447	5.76	367	1.46	13,826	55.04	4,523	18.01	3,893	15.50
Kentucky	23,443	1.51	288	1.23	229	.98	733	3.13	2,805	11.97	696	2.97	8,926	38.08	5,126	21.87	4,639	19.79
Louisiana	31,966	2.06	68	.21	351	1.10	452	1.42	1,128	3.53	714	2.23	18,426	57.64	6,760	21.15	4,068	12.73
Maine	8,309	.54	82	.98	132	1.59	160	1.93	908	10.92	205	2.47	3,395	40.86	1,998	24.05	1,429	17.19
Maryland	25,692	1.66	97	.38	84	.33	470	1.83	1,380	5.37	684	2.66	13,883	54.04	4,926	19.17	4,169	16.23

Massachusetts	36,390	2.35	386	1.06	441	1.21	741	2.04	2,187	6.01	1,341	3.68	15,296	42.03	8,387	23.05	7,612	20.92
Michigan	64,542	4.16	457	.71	536	.83	1,396	2.16	2,428	3.76	938	1.45	33,556	51.99	14,417	22.34	10,812	16.75
Minnesota	33,044	2.13	276	.84	614	1.86	614	1.86	2,314	7.00	569	1.72	16,900	51.14	7,660	23.18	4,096	12.40
Mississippi	20,921	1.35	249	1.19	255	1.22	396	1.89	1,013	4.84	566	2.71	12,268	58.64	4,385	20.96	1,789	8.55
Missouri	34,081	2.20	127	.37	317	.93	634	1.86	2,958	8.68	763	2.24	17,871	52.44	5,646	16.57	5,765	16.92
Montana	8,602	.55	76	.88	45	.52	185	2.15	833	9.68	172	2.01	4,471	51.98	1,367	15.89	1,453	16.89
Nebraska	17,304	1.12	119	.69	218	1.26	448	2.59	1,379	7.97	294	1.70	8,171	47.22	4,330	25.02	2,344	13.55
Nevada	3,531	.23	1	.03	6	.18	49	1.39	154	4.35	60	1.70	2,781	78.76	241	6.82	238	6.75
New Hampshire	5,161	.33	13	.25	51	.98	74	1.44	396	7.68	147	2.85	2,559	49.59	1,053	20.41	867	16.81
New Jersey	45,906	2.96	97	.21	295	.64	457	1.00	2,491	5.43	1,160	2.53	20,302	44.23	12,859	28.01	8,244	17.96
New Mexico	10,111	.65	26	.25	68	.67	197	1.95	1,136	11.24	176	1.74	4,668	46.17	2,599	25.71	1,240	12.26
New York	118,139	7.62	819	.69	359	.30	2,784	2.36	9,354	7.92	2,728	2.31	59,577	50.43	20,136	17.04	22,381	18.94
North Carolina	45,065	2.91	343	.76	500	1.11	1,782	3.96	4,473	9.92	1,370	3.04	16,678	37.01	10,421	23.12	9,497	21.08
North Dakota	7,413	.48	94	1.27	99	1.33	151	2.04	581	7.84	216	2.91	3,380	45.60	1,809	24.40	1,084	14.62
Ohio	83,165	5.37	480	.58	597	.72	1,220	1.47	3,587	4.31	1,223	1.47	48,406	58.20	19,596	23.56	8,057	9.69
Oklahoma	25,773	1.66	158	.61	360	1.40	635	2.46	1,281	4.97	540	2.10	12,067	46.82	6,184	24.00	4,548	17.64
Oregon	18,855	1.22	158	.84	150	.80	353	1.87	1,112	5.90	396	2.10	9,927	52.65	3,888	20.62	2,871	15.22
Pennsylvania	79,492	5.13	410	.52	220	.28	1,002	1.26	5,205	6.55	1,410	1.77	40,469	50.91	17,151	21.58	13,625	17.14
Rhode Island	5,920	.38	24	.40	24	.41	137	2.32	349	5.90	237	4.01	2,671	45.12	1,623	27.42	855	14.44
South Carolina	23,187	1.50	140	.61	238	1.03	267	1.15	1,052	4.54	457	1.97	10,517	45.36	6,222	26.84	4,294	18.52
South Dakota	8,565	.55	111	1.29	121	1.41	330	3.85	829	9.68	272	3.18	2,917	34.06	2,297	26.82	1,688	19.71
Tennessee	31,328	2.02	160	.51	214	.68	1,057	3.37	3,104	9.91	501	1.60	13,533	43.20	7,315	23.35	5,444	17.38
Texas	92,031	5.94	139	.15	266	.29	627	.68	3,507	3.81	821	.89	52,919	57.50	24,005	26.08	9,745	10.59
Utah	10,097	.65	145	1.44	165	1.63	382	3.78	563	5.57	516	5.11	4,693	45.48	2,254	22.32	1,481	14.67
Vermont	3,723	.24	22	.59	16	.43	165	4.43	591	15.87	135	3.63	1,640	44.07	334	8.98	819	22.00
Virginia	34,409	2.22	194	.56	158	.46	345	1.00	2,621	7.62	735	2.14	20,280	58.94	4,660	13.54	5,417	15.74
Washington	29,142	1.88	236	.81	210	.72	165	.57	2,281	7.83	576	1.98	15,980	54.84	5,583	19.16	4,110	14.10
West Virginia	17,085	1.10	139	.81	380	2.22	566	3.31	1,527	8.94	286	1.67	6,182	36.18	4,383	25.66	3,622	21.20
Wisconsin	32,558	2.10	108	.33	146	.45	566	1.74	1,816	5.58	683	2.10	18,990	58.32	6,654	20.44	3,595	11.04
Wyoming	4,522	.29	12	.27	43	.94	54	1.19	396	8.75	130	2.87	1,990	44.01	1,437	31.77	461	10.20
Grand total	1,550,024	100	9,842	.63	12,264	.79	29,823	1.92	103,286	6.66	32,479	2.10	803,669	51.85	325,422	20.99	233,238	15.05
50 States and District of Columbia	1,535,809	99.08	9,749	.63	11,826	.77	28,455	1.85	101,915	6.64	31,763	2.07	801,323	52.18	321,289	20.92	229,490	14.94
Outlying parts	14,216	.92	93	.66	438	3.08	1,368	9.62	1,371	9.65	716	5.04	2,347	16.51	4,134	29.08	3,748	26.36
Canal Zone	504	.03	0	0	8	1.59	3	.60	62	12.30	10	1.98	187	37.10	77	15.28	157	31.15
Guam	408	.03	0	0	17	4.12	16	3.82	25	6.13	19	4.71	68	16.69	125	30.60	138	33.93
Puerto Rico	13,155	.85	89	.68	413	3.14	1,349	10.26	1,241	9.44	670	5.10	2,023	15.38	3,932	29.89	3,436	26.12
American Samoa	149	.01	4	2.68	0	0	0	0	43	28.86	17	11.41	69	46.31	0	0	16	10.74
Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX TABLE B

Average expenditure per classroom in public elementary and secondary schools State for the United States, 1964

State	Elementary		Secondary	
	New	Addition	New	Addition
Alabama	19,700	23,500	32,600	
Alaska	49,000	31,500	71,400	
Arizona	20,500	20,400	26,100	
Arkansas	22,000	26,000	29,000	
California	38,100	36,400	51,200	
Colorado	38,400	28,000	50,200	
Connecticut	50,000	46,000	48,400	
Delaware	46,000	6,200	78,000	
Florida	21,000	25,000	38,000	
Georgia	22,000	21,300	29,100	
Hawaii	35,200	28,200	47,300	
Idaho	30,000	29,000	44,000	
Illinois	63,000	44,100	97,000	
Indiana	36,200	38,000	51,000	
Iowa	29,000	25,400	37,300	
Kansas	29,000	26,000	39,000	
Kentucky	22,200	21,000	24,400	
Louisiana	18,300	60,000	34,000	
Maine	39,400	31,400	31,400	
Maryland	45,000	38,000	48,400	
Massachusetts	49,100	39,000	54,100	
Michigan	34,000	31,000	54,000	
Minnesota	34,200	38,400	51,000	
Mississippi	29,300	21,000	38,400	
Missouri	43,000	32,200	41,400	
Montana	27,100	25,000	66,000	
Nebraska	36,900	32,500	42,200	
Nevada	20,500	22,500	33,800	
New Hampshire	30,600	29,500	21,600	
New Jersey	38,600	41,800	56,900	
New Mexico	21,400	23,100	42,200	
New York	53,000	49,300	60,600	
North Carolina	23,600	18,700	36,400	
North Dakota	39,300	36,000	42,200	
Ohio	34,200	29,300	42,900	
Oklahoma	18,000	20,800	35,000	
Oregon	32,700	32,900	62,800	
Pennsylvania	49,300	43,900	69,800	
Rhode Island	35,600	29,500	46,000	
South Carolina	20,500	22,200	41,000	
South Dakota	33,700	10,600	43,100	
Tennessee	15,000	20,300	39,300	
Texas	21,400	22,300	35,100	
Utah	41,200	29,900	47,700	
Vermont	35,000	18,600	44,700	
Virginia	59,700	26,800	39,900	
Washington	39,500	36,000	47,700	
West Virginia	20,200	20,400	85,500	
Wisconsin	35,400	35,100	45,400	
Wyoming	20,600	15,000	35,000	

Source: *School Management:* "Trends: A State-by-State Examination of Dollars Spent fo
struction for 4 Years," July 1965, pp. 112–137.

CHAPTER 17

Nonpublic Elementary and Secondary School Facilities*

A. NATURE AND COMPOSITION OF NONPUBLIC SCHOOLS

1. DESCRIPTION OF FACILITIES

Physical Characteristics

The predominant type of school building used for nonpublic schools ·istive (52 percent), multistory (56 percent), masonry exterior ·nt), with steel (34 percent) or masonry framing (27 percent). Nonpublic schools can be subdivided into church related, and ·h related or private. Church-related schools are pre- ·tly Roman Catholic. Roman Catholic schools are generally ·n the more populated areas of the Nation and the profile of characteristics described above is greatly influenced by the number of Roman Catholic schools. Some Roman Catholic, church-related schools, and private schools are located in the "preparatory" school setting of multiple building campuses large acreage. This is evident from the large number of acres the mean as compared to the median size of site for nonpublic (See table 1.)

1.—*Number of acres in the median non-public-school site by organizational level for selected periods for the United States, 1965*

	Elementary	Combined	Secondary
----------	1	2	7
----------	2	5	8
----------	3	6	14
Median, all sites----------	2	4	10
Mean, all sites----------	5	26	50

Source: Based on George J. Collins, *"National Inventory of School Facilities and Personnel, Spring 1962."* U.S. Department of Health, Education, and Welfare, Office of Education, 1964.

Services Rendered

Nonpublic schools serve the Nation in a free society by providing choices to parents in fulfilling the requirements of compulsory ·n outside of public education. For some, these choices may a school where religion is taught, or the quality of education for smaller class size and a greater emphasis on individual ·on, or a chance to live in a total school environment away home. In another sense, nonpublic schools serve the State in g schools which eliminate the necessity of providing additional schools. Nonpublic schools serve the population from ages 3 19 years with nursery, kindergarten, elementary, secondary, and ndary or preparatory educational programs (see table 2).

*This chapter was prepared by Dr. George J. Collins, National Center for ıal Statistics, Office of Education, Department of Health, Education, ·re, with minor editing by committee staff.

TABLE 2.—*Fall enrollment by organizational level of public and nonpublic schools for the United States, 1965–66*

	Total		Elementary [1]		Secondary [2]	
	Number	Percent	Number	Percent	Number	Percent
1965	48,744,000	100	31,716,000	65.1	17,028,000	34.9
Public	42,144,000	86.4	26,416,000	54.2	15,728,000	32.3
Nonpublic	6,600,000	13.5	5,300,000	10.9	1,300,000	2.7

[1] Elementary includes nursery and kindergarten schools.
[2] Secondary includes postsecondary or preparatory schools.

Source: Samuel Schloss, "*Fall 1965 Statistics of Public Schools*"; and Kenneth A. Simon, "*Digest of Educational Statistics*"; Washington, U.S. Department of Health, Education, and Welfare, Office of Education, 1966.

(c) *Standards of Performance*

Standards of performance are not available on a per capita basis. The ratio of pupils to instructional rooms provides one widely used measure of the adequacy of school facilities. The median nu... pupils in a room for elementary schools is 39.2 and for secondary schools, 25.4 pupils. The comparable medians for public schools are 27.6 for elementary and 26.3 for secondary school pupils. The disparity in pupil accommodations in nonpublic schools is shown in table 4. Especially noteworthy is the comparison between public and nonpublic schools in the proportions of pupils accommodated classrooms with 40 or more pupils.

TABLE 4.—*Estimated number and percent of pupils in a room of public and nonpublic schools for the United States, 1965*

	Nonpublic		Public	
	Number	Percent	Number	Percent
Less than 20	891,000	13.5	5,978,000	14.2
20 to 29	1,405,800	21.3	23,576,000	
30 to 39	1,900,800	28.8	10,904,000	25.9
40 or more	2,402,400	36.4	1,632,000	3.9

Source: Based on *National Inventory of School Facilities and Personnel, Spring 1962*. Washington, U.S. Department of Health, Education, and Welfare, Office of Education, 1964.

Table 5 shows the number of additional rooms needed to eliminate the crowded conditions in nonpublic schools using varying kinds of pupil accommodation. As this table makes clear, the overwl majority of additional rooms needed to eliminate overcrowding for Roman Catholic schools.

—*Number of additional instructional rooms needed to eliminate overcrowding in nonpublic school as determined by varying measures of pupil accommodation for the United States, 1965–66*

	Total nonpublic	Roman Catholic	Other church related	Private
Elementary, 25 pupils; secondary, 20 pupils.	81,000	78,000	2,200	800
olic median) Elementary, 27.6 pupils; secondary, 26.3 pupils.	55,200	53,700	1,100	400
Elementary, 30 pupils; secondary, 30 pupils.	41,400	40,400	700	300

Source: Based on *National Inventory of School Facilities and Personnel, Spring 1962.*

Another standard of performance is the number of general-use rooms to accommodate the pupil population. Table 6 shows the number and percent of pupils without four types of general-

—*Estimated number and percent of pupils in nonpublic schools without libraries, auditoriums, gymnasiums, and cafeterias for the United States, 1965–66*

General-use facility	Number of pupils	Percent
raries	2,442,000	37
toriums	1,914,000	29
masiums	2,366,000	51
terias	2,112,000	32

Source: Based on *National Inventory of School Facilities and Personnel, Spring 1962.*

The number of general-use facilities needed to replace combustible s and eliminate overcrowding is shown in table 7.

7.—*Number of general-use facilities needed to eliminate overcrowding and to replace inadequate facilities in nonpublic schools for the United States, 1965–66*

General-use facilities	Combustible	Major renovation or replacement	Overcrowding	Total	Annual construction rate
Total	3,200	9,050	33,000	45,250	18,400
	850	2,300	10,500	13,650	4,600
	700	2,200	8,100	11,000	2,000
s	200	550	7,000	7,750	1,100
	450	1,500	7,400	9,350	2,200
	400	1,000		1,400	4,300
e	600	1,500		2,100	2,200

NOTE.—This table is based on the number of combustible and overcrowded facilities reported in the *National Inventory of School Facilities and Personnel, Spring 1962.* The need is based on accommodating 200 elementary schools and 400 pupils in secondary schools. The need could be reduced if areas were multiple purposes.

(d) *Structural Standards of Performance*

Nonpublic schools were using about 227,000 instructional rooms in the school year 1965–66. About 8,400 were improvised or makeshift and about 9,500 were nonpermanent. (See table 8.) About 79,700 rooms or 36 percent of the nonpublic school rooms are combustible, constructed before 1920, makeshift, or nonpermanent.

TABLE 8.—*Number and percent of rooms in public and nonpublic schools United States, 1965*

	Nonpublic		Public	
	Number	Percent	Number	Percent
Total (unduplicated)	79,700	34.2	397,500	
Completed before 1920	51,300	23.6	214,000	
Combustible	15,900	7.3	155,000	
Makeshift or improvised	9,400	3.7	32,500	2.1
Nonpermanent	9,500	4.2	46,000	

NOTE.—About 7,400 rooms are both combustible and completed before 1920 in nonpublic about 50,000 public school rooms are in each category. Based on the *National Inventory of Sch and Personnel.*

Many of the structures completed before 1920 could be remodeled or renovated; some should be abandoned. Public school officials reported 233,000 rooms or 15 percent needed major remodeling or renovation and 182,000 rooms or 13 percent were inadequate or should be abandoned. (See table 10 of chapter 16 on public elementary secondary school facilities.)

There is every reason to believe that nonpublic schools would exceed the percentages for public schools in each of these categories for renovations and inadequate rooms with nearly 10 percent more rooms in older buildings than public schools. (See table 8.)

2. EXISTING CAPITAL PLANT IN THE UNITED STATES

(a) It is estimated that in 1965–66 there are 227,000 instructional rooms in nonpublic schools. In addition to the instructional there are 38,600 general-use facilities (see table 9).

TABLE 9.—*Estimated number of general-use facilities in nonpublic schools for the United States, 1965–66*

	Number
Total	
Centralized school libraries	9,800
Auditoriums	5,600
Cafeterias	8,500
Gymnasiums	2,700
Combination facilities [1]	6,900
Auditoriums	(6,800)
Cafeterias	(3,200)
Gymnasiums	(4,900)
Other multipurpose rooms	6,800

[1] Facilities with more than 1 function; i.e., auditorium-cafeteria.

(b) *Distribution of Facilities by State*

Table 10 shows the estimated distributions, by State, of pupils, school plants, and classrooms in 1965–66. Data in this table have been updated to take account of estimated growth since the 1962 inventory.

TABLE 10.—*Estimated number of school plants, schools, pupils, and rooms in nonpublic schools for the United States, 1965–66*

	School plants	Schools	Pupils	Rooms
Total	16,600	19,000	6,600,000	227,000
Alabama	150	180	33,000	1,520
Alaska	30	35	3,000	250
Arizona	120	140	35,000	1,270
Arkansas	80	100	13,000	650
California	1,140	1,285	432,000	15,250
Colorado	170	190	45,500	1,800
Connecticut	290	320	121,000	4,980
Delaware	40	55	20,000	750
District of Columbia	60	75	26,500	1,100
Florida	310	380	96,500	3,700
Georgia	90	110	25,500	1,200
Hawaii	80	105	29,500	1,150
Idaho	50	60	10,500	380
Illinois	1,240	1,290	189,500	17,900
Indiana	460	490	150,000	4,850
Iowa	430	510	108,000	4,150
Kansas	270	290	54,500	2,350
Kentucky	330	370	98,000	3,670
Louisiana	300	500	151,500	5,130
Maine	140	160	37,500	1,650
Maryland	300	360	138,500	4,700
Massachusetts	630	750	282,000	9,850
Michigan	920	1,120	367,000	11,850
Minnesota	570	630	183,000	6,480
Mississippi	60	85	19,000	850
Missouri	560	590	187,000	6,550
Montana	90	100	23,500	960
Nebraska	300	330	62,500	2,420
Nevada	20	20	4,500	140
New Hampshire	110	140	38,500	1,520
New Jersey	560	640	324,000	9,900
New Mexico	120	150	28,500	1,170
New York	1,620	1,870	922,000	28,800
North Carolina	150	175	22,000	1,200
North Dakota	100	115	23,000	1,020
Ohio	870	940	433,000	14,400
Oklahoma	120	145	22,000	1,220
Oregon	170	190	39,000	1,600
Pennsylvania	1,160	1,280	658,000	20,600
Rhode Island	130	170	54,500	1,980
South Carolina	60	75	16,000	700
South Dakota	90	100	22,000	920
Tennessee	150	180	34,000	1,750
Texas	530	610	164,000	6,060
Utah	30	40	8,000	310
Vermont	60	60	20,000	850
Virginia	180	220	58,500	2,730
Washington	230	290	61,500	2,380
West Virginia	80	290	18,500	780
Wisconsin	830	870	282,000	9,080
Wyoming	20	20	4,500	530

Source: Based on George J. Collins' "*National Inventory of School Facilities and Personnel*," spring 1962. Washington: U.S. Department of Health, Education, and Welfare, Office of Education, 1964. (See text.)

(c) *Distribution by Population Size*

An estimate of the approximate distribution of rooms among the six size classifications is reported in table 11. In comparison with the distribution of public schools, a significantly larger proportion of nonpublic schools is located in large cities.

TABLE 11.—*Estimated number of rooms in nonpublic schools by populati city for the United States, 1965–66*

Population of cities	Rooms	Percent
Total	227,000	
500,000 or more	51,000	22.5
100,000 to 499,999	58,000	25.6
50,000 to 99,999	36,000	
10,000 to 49,999	41,000	18.1
2,500 to 9,999	9,000	
Under 2,500	32,000	14.1

(d) *Completion Date of Rooms*

An analysis of structural characteristics of school buildings indicates that three periods of construction are significant: Before 1920, 1920–40, and after 1940. More than one-half (57 percent) of the rooms in use in nonpublic schools have been completed since World War II. For public schools during this same period there were 60 percent. The investment in nonpublic school facilities parallels public school construction with two exceptions. For the period of construction before 1920, nonpublic schools have 21 percent of their classrooms in use today, while public schools have only 14 percent. The numerical difference shows public schools with 214,000 rooms in use today and nonpublic 48,000, which have been in use for over 45 years.

From the construction period between 1920–39 public schools obtained 26 percent of their rooms, while nonpublic schools have 21 percent.

TABLE 12.—*Estimated number and percent of instructional rooms in permanent buildings of nonpublic schools by date of completion for the United States, 1965–66*

Date of completion	Number	Percent
Total	227,000	100
Before 1920	48,000	21
1920 to 1929	32,500	14
1930 to 1939	16,000	7
1940 to 1949	19,000	8
1950 to 1959	66,000	29
1960 to 1966	45,500	20

(e) *Ownership*

Less than 1 percent of the 16,600 school plants are on school sites owned by public authorities. More appropriately, the ownership of non-public-school facilities may be divided by Roman Catholic, other church-related schools, and private school plants (see table 13). A school plant may house one or more schools, such as an elementary school (grades kindergarten to 8) and a high school (9 to 12). Thus, there are approximately 19,000 nonpublic schools in 16,600 school plants.

...—*Estimated number of non-public-school plants by religious affiliation for the United States, 1965–66*

Classification	Number	Percent
Total	16,600	100.0
...olic	12,000	72.1
...related	3,200	19.5
Private	1,300	7.7
...	100	.7

NOTE.—Enrollment distributions are different: Roman Catholic is 90 percent.

Estimated Current Value

The estimated current value of non-public-school facilities is $5.7 ... but the replacement value at current costs would be $9 billion. ... computation for current value is based on an expenditure of ... per classroom constructed in 1964 with a 2.5-percent reduc- according to the Boeckh Construction Index. The value of ...ms completed over 40 years ago, however, is corrected to ... Consequently, the values of those rooms completed from 1920 to 1930 are also adjusted proportionately to correspond with the ...n factor needed for rooms that have been in use over 40 years (table 14). This correction adds $418 million to the value of non- ...hool facilities.

TABLE 14.—*Estimated value of non-public-school facilities, 1965–66*

	Boeckh	Adjusted	Rooms	Total value
Total			227,000	$5,739,500,000
...	9,000	$15,000	48,000	720,000,000
...	12,000	16,000	32,600	520,000,000
...	17,000	17,000	16,000	272,000,000
...	22,500	22,500	19,000	427,500,000
...	30,000	30,000	66,000	1,980,000,000
...	40,000	40,000	45,400	1,820,000,000

B. COSTS AND USERS COSTS

1. CONSTRUCTION COST AND OPERATION COSTS

Construction Cost

Available information on the cost of nonpublic school facilities is ...tary. It may be assumed that the range in cost is similar to that reported in the chapter on public elementary and secondary ... and that variations among States are also similar to those ...n appendix table B of that chapter. There is good evidence, discussions with nonpublic school officials, that facilities costs nonpublic schools are moderately lower than those for public ... at the same grade levels. This is mainly because nonpublic ... have usually provided somewhat smaller sites, have depended heavily on multistory construction and have provided less costly amenities, such as lavatories. Secondary facilities are more costly than elementary; and in recent years, a pronounced trend in

Catholic schools toward concentration on the development of ary education has resulted in an average cost per classroom for school construction which is somewhat higher in the nonpublic in the public sector.

(b) *Maintenance and Operating Expenditures*

Comprehensive information on the cost of maintaining and operating nonpublic school facilities is not available. It is assumed that penditures approximate those reported in the chapter on publi facilities. However, because, on the average, a larger number nonpublic school pupils are accommodated in a classroom, it probable that per pupil expenditures for these purposes are so lower in nonpublic schools.

2. USER CHARGES

(*a*) and (*b*) Although many pupils are accepted in nonpublic on full or partial scholarships, the majority pay tuition and fees, which range from a few dollars to several thousand dollars a year. nere no precise information available on the proportion of nonpublic cational expenditures which are met from charges to students, known that these charges almost invariably leave a deficit to be from other sources. Whether the deficit should be allocated to tenance and operating expense and debt service or to other educational costs is largely an arbitrary matter.

(*c*) At the present time, costs of nonpublic elementary and ary facilities are not met to any significant degree from tax resc general obligation borrowings of State and local government units.

C. Trend of Capital Outlay

1. 1940–65

The nonpublc schools like the public schools, have made an mous effort to accommodate the huge postwar increase in the school-age population; and from 1940–50 to 1960–66, the average annual penditure for nonpublic elementary and secondary facilities i more than 600 percent. (See table 15.) Expressed as a proportion of new public school classrooms, however, the rooms constru nonpublic schools declined from an average of 18 percent in th of the forties to 9 percent in the period 1960–66. For a cons period, the average number of nonpublic classrooms completed year has remained relatively constant, but costs have continued rise substantially, both because of the increasing emphasis on ary school construction and also because of the continuing increase in building costs.

Table 15.—*Estimated capital outlay for nonpublic elementary and second facilities, 1946–65*

[Dollar amounts in thousands]

Year	Rooms constructed			Expenditures		
	Total	Annual	Percent of public	Total	Annual	Percent of public
1940–49	19,000	1,900	18	$427,500	$42,750	
1950–59	66,000	6,600	13	1,980,000	198,000	
1960–66	45,400	6,500	9	1,820,000	260,000	

2. SPENDING AGENCIES FOR CAPITAL OUTLAYS

Funds from local, State, and Federal Governments to nonpublic
are estimated as very small. Public ownership of 0.7 percent
the nonpublic school sites, however, was reported in the National
y of School Facilities and Personnel conducted by the Office
Education in the spring of 1962. The number of profitmaking
ons is also very small. It is estimated that about 98 percent
the funds for capital outlays shown in table 15 were accounted for
nonprofit organizations.

3. SOURCE OF FINANCING FOR CAPITAL OUTLAYS

Financing of capital construction for nonpublic schools is primarily
gifts. However, mortgages are used in some instances, and
are also provided from higher echelons of church-related
ons.

D. Needs and Prospective Capital Outlays

1. CAPITAL REQUIREMENTS

Establishment of facility standards and decisions about capital
r nonpublic schools are the responsibility of the organizations
operate those schools. It might be assumed that it would be
to generalize at least about the Catholic schools, which account
rcent of the nonpublic enrollment. However, control of these
as been largely decentralized and standards are known to vary

In this section, mainly to facilitate comparison between the public
private sectors, the present median pupil accommodation in the
schools will be used as the basis for estimates. It cannot be
, however, that this basis is or will be accepted as a standard
ublic school officials. It should be noted, furthermore, that
o finance the necessary capital outlay usually represents only
first step toward achieving smaller classes in schools which now
odate large numbers of pupils in each room. This is because
number of pupils per room often corresponds closely to the
of pupils per teacher. The amortized per pupil cost of addi-
ssrooms is by no means small, but it is substantially less than
of the teachers required to staff the rooms. For all of these
estimates of capital outlay requirements given here should
recognized as primarily for purposes of illustration.

In the decade 1956 through 1965, estimated enrollments in nonpublic
ncreased from about 4.4 million to about 6.6 million. In the
through 1975, the anticipated increase will be much smaller:
Office of Education projections place the 1975 enrollment at
7 million.

Hence, it appears possible that the nonpublic schools may be able to
me inroads during this decade on their very large backlog of
ated needs. It must be anticipated, however, that a sub-
backlog will still remain at the end of the decade, unless these
an develop new sources of financing.

Total estimated needs for the decade are summarized below:

(a) Replacement and renovation of dilapidated and obsolete facilities [1]
(b) Elimination of present overcrowding
(c) Accommodation of added enrollment, including allowance for migration

Total

[1] This estimate assumes that all makeshift, nonpermanent, combustible, and off-site room the remaining rooms built prior to 1920 would be replaced. It also assumes that of the 171,000 e which would remain in use, 34,000 would be completely renovated. The new classroom equiv renovated facilities is estimated as 8,500 rooms.

The outlay required for these facilities at current estimated costs for nonpublic schools—about $40,000 per classroom—would approximately $6 billion.

No confident predictions can be made about actual future c tion of nonpublic classrooms. During the decade 1956 through under extraordinary enrollment pressures, construction averag 6,600 rooms per year. However, resources of the schools are to be severely strained, and it is unlikely that they will be able continue building at this rate. Without assistance from new of funds, it appears likely that average annual construction exceed 6,000 rooms.

If construction in 1966–75 approximates 6,000 classrooms a total outlay during the decade, assuming a cost increase of 3 per year, would be about $2.8 billion.[1] The backlog of unmet remaining at the end of the decade (on the basis from which needs have been estimated here) would be about 89,000 rooms, costs projected to 1975—between $4.5 and $5 billion.

2. DISTRIBUTION BY POPULATION SIZE OF COMMUNITY

It is impossible to estimate closely the future distribution c outlay by size of community. Nonpublic school students, at are very heavily concerntrated in urban areas. Hence, a aimed primarily at replacing obsolete buildings and reducing overcrowding would require the bulk of the construction in t However, enrollment increases, as in the public schools, are ex be mainly in the suburbs and the needs of these new pupils are to receive priority in allocation of limited funds. The dis below is presented with the proviso that any estimate represe more than a guess:

SMSA's—Urban
SMSA's—Urban fringe
Outside SMSA's

Total

3. SPENDING AGENCIES FOR CAPITAL OUTLAYS

Barring some unforeseen development in the pattern of organization, the overwhelming majority (i.e., 98 percent or more) expenditures for capital outlay will be by private nonprofit c tion.

[1] This reflects an estimated average cost over the decade of nearly $47,000 per classroom. Se for a discussion of construction cost differences between public and nonpublic schools.

CHAPTER 18

Area Vocational School Facilities *

A. NATURE AND COMPOSITION OF FACILITIES

1. INTRODUCTION [1]

In a broad sense, all education contributes to vocational competency, ır technology grows in complexity, the basic general education ents for successful employment in most fields are increasing more rapidly than could have been anticipated even a decade two ago. But as occupations become more specialized, as well demanding, the broad general accomplishments of the stand- .. school curriculum constitute less and less a sufficient quali- for satisfying employment, and more and more are only a y prerequisite for the acquisition of specific occupational skills. hese implications of a changing job market are recognized and in an educational system which can anticipate future needs, plight of today's high school dropout may increasingly become plight of tomorrow's high school graduate.

More and more, in other words, we are moving into an era of al specialization for all. However, while it is clear that the ı, the architect, the lawyer, and the international expert, for receive specific occupational preparation in their specialized schools, the term "vocational education" has not traditionally used to refer either to such professional training nor to the l, although still only partially specialized, liberal arts ɜ leading to a baccalaureate degree. As it is now commonly vocational education refers to all formal occupationally ɔd *subprofessional* instruction, which may be offered as part a regular secondary or postsecondary educational program or may especially designed for those who have dropped out of school or been long absent from formal educational activities. The nay be youth or adult, and the student's goal in such training be either initial entry into or advancement within the chosen onal field.

With this very broad definition, it is clear that the field of vocational n potentially encompasses part of the formal education all of the great majority of Americans who do not complete reate programs. Thus, it is not suprising that the Federal for vocational education, which is distributed through the goes ultimately to about two-thirds of the public secondary

* Prepared by Program Planning and Development Branch, Division of Voca- and Technical Education, Bureau of Adult and Vocational Education, Office of Education, with minor editing by committee staff.

[1] This section is intended primarily to define the scope and limitations of this chapter.

schools in the country, to most of the public community and junior colleges, and even to many of the 4-year institutions of higher education. Table 1, which summarizes data reported by the States, provides a 20-year record of enrollments in programs receiving this support.

TABLE 1.—*Enrollment in vocational education classes*

[In thousands]

Fiscal year	Total [1]	Adult	Postsecondary	Secondary	Persons with special needs
1945	2,013	609	466	939	..
1946	2,228	715	525	987	..
1947	2,509	854	609	1,045	..
1948	2,836	1,210	522	1,105	..
1949	3,096	1,373	560	1,163	..
1950	3,365	1,521	596	1,247	..
1951	3,363	1,475	562	1,326	..
1952	3,166	1,326	475	1,365	..
1953	3,100	1,218	444	1,438	..
1954	3,165	1,313	362	1,490	..
1955	3,314	1,389	396	1,529	..
1956	3,413	1,456	399	1,558	..
1957	3,522	1,523	385	1,613	..
1958	3,629	1,577	388	1,664	..
1959	3,701	1,642	343	1,717	..
1960	3,768	1,686	341	1,741	..
1961	3,856	1,725	348	1,783	..
1962	4,073	1,825	329	1,919	..
1963	4,217	1,908	359	1,950	..
1964	4,566	2,025	400	2,141	..
1965	5,431	2,379	[2] 207	2,819	..
1966 [4]	5,790	2,514	580	2,696	[5]
1967 [4]	6,368	2,786	726	2,857	[5]

[1] Detail may not add to total because of rounding.
[2] Apprentice enrollment included under adult. Prior to fiscal year 1965, apprentices are s postsecondary.
[3] Represents enrollment in adult and remedial programs for prevocational training in basic skills.
[4] Projected figures for these 2 years.
[5] Although enrollments in these programs are expected to grow rapidly, there is no adequat projection.

NOTE.—Data in this table do not include enrollments in programs under the Manpower I and Training Act.

Because increasing proportions of young people are baccalaureate programs or at least deferring occupational specialization until they have completed high school, it is especially noteworthy that the number of secondary students in vocational programs have represented, during this 20-year period, a fairly constant proportion—approximating 20 percent—of all public school enrollments in grades 9 through 12. In part, this may reflect a broadening in the d of vocational education, but it also reflects a growing awareness an "academic" or "general" curriculum which terminates at the school level no longer provides, for many students, a very good preparation for entry into the labor market. There is good evidence the States are increasingly alert to the expanding needs for occupational training and that they are moving rapidly to broaden the of opportunities for occupational training and to bring these opportunities within reach of more of those who can benefit from them.

Since most vocational programs are carried out in conjunction more comprehensive education programs (and use, at least in part, joint facilities) it is not now possible to provide any complete accounting of vocational facilities *per se*. Most of these must be included under elementary and secondary schools or under higher education. In part, however, facilities for a small but growing seg-

of the vocational education enterprise can be fairly clearly
shed. These are the facilities for a group of institutions
ıve come to be known as area vocational schools and which
one of the most significant efforts to expand vocational
opportunities. It should be noted that an important focus
these schools is on the victims of a changing technology, including
whose jobs have disappeared and those whose skills must be
and expanded for them to function effectively in jobs which
been redefined. Thus, there is only partial overlap between
schools and the existing educational establishment, and it is
ate to treat them separately. Accordingly, information
l in this chapter pertains exclusively to area vocational school

2. DESCRIPTION OF FACILITIES

General Characteristics of Area Vocational Schools

The core of meaning in the phrase "area vocational education
is best indicated by the language in the Vocational Education
of 1963 which defines such schools to include:

> (A) A specialized high school used exclusively or principally for the provision of vocational education to persons who are available for full-time study in preparation for entering the labor market, or
>
> (B) The department of a high school exclusively or principally used for providing vocational education in no less than five different occupational fields to persons who are available for full-time study in preparation for entering the labor market, or
>
> (C) A technical or vocational school used exclusively or principally for the provision of vocational education to persons who have completed or left high school and who are available for full-time study in preparation for entering the labor market, or
>
> (D) The department or division of a junior college or community college or university which provides vocational education in no less than five different occupational fields, under the supervision of the State board, leading to immediate employment but not leading to a baccalaureate degree,
>
> ilabe to all residents of the State or an area of the State designated and by the State board, and if, in the case of a school, department, or division in (C) or (D), it admits as regular students both persons who have high school and persons who have left high school.

Standard of Performance

The necessity for developing vocational school facilities on an area
ects the fact that shops, laboratories and other special spaces
for training in many occupational fields cannot be eco-
y provided for very small numbers of students. This point
illustrated by the following estimates of minimum facilities for
ıctivities:

	Square feet
l agricultural shop	2, 400
s laboratory	3, 200
hanics facility	6, 000

When such a school can be designed to serve a sufficiently large
on, however, the physical area (about 100 square feet per
and the cost per student of adequate facilities appear com-
to those for secondary schools in general. Similarly, there is
reason to anticipate differences between these two types of schools
the useful life of the average physical structure, which may be
d at 30 to 40 years or more, depending on structural charac-
and quality of maintenance. Because vocational schools are

more dependent on specialized equipment, however, it must be anticipated that they will have a somewhat higher overall rate of obsolescence. This point deserves emphasis, because much vocational education involves training in quite specific skills and the student who receives his training on out-of-date equipment will enter the ... market with a very serious handicap.

(c) *Existing Capital Plant in the United States*

As of 1965, based on reports from the States, 613 institutions, either completed or under construction, had been designated area vo educational schools. The distribution of these schools by State shown in table 2. The distribution by population size of city is not known.

Of these 613 schools, 144 represented new construction and 64 had been remodeled since 1963,[2] but information as to the age of the remaining schools has not been reported.

TABLE 2.—*Distribution of area vocational schools by State, 1965*

Alabama	15	New Hampshire	
Alaska	1	New Jersey	17
Arizona	8	New Mexico	2
Arkansas	8	New York	8
California	78	North Carolina	24
Colorado	4	North Dakota	1
Connecticut	25	Ohio	
Delaware	3	Oklahoma	2
District of Columbia	6	Oregon	11
Florida	5	Pennsylvania	17
Georgia	20	Rhode Island	7
Hawaii	5	South Carolina	
Idaho	5	South Dakota	1
Illinois	---	Tennessee	
Indiana	2	Texas	
Iowa	---	Utah	
Kansas	10	Vermont	11
Kentucky	14	Virginia	
Louisiana	32	Washington	
Maine	5	West Virginia	
Maryland	6	Wisconsin	
Massachusetts	3	Wyoming	
Michigan	19	Canal Zone	---
Minnesota	19	Guam	---
Mississippi	18	Puerto Rico	
Missouri	14	Virgin Islands	---
Montana	2		
Nebraska	4	Total	
Nevada	1		

All of these area schools are publicly owned and are admi either by State or by local boards of education. Based on infc furnished by the States, their estimated total value in 1965 v million.

B. COSTS AND USER CHARGES

There are substantial variations, both among regions and the same region, in the cost of constructing and equipping vc school facilities. Nationwide, in 1964–65, construction costs ranged

[2] Among the 208 newly constructed or remodeled schools were: 27 specialized high schools, 62 of comprehensive high schools, 76 technical or vocational schools, and 43 departments in in higher education. A similar breakdown by type for the remaining area schools is not available.

... to $27 per gross square foot, with an average of approximately ... per foot, or about $1,850 per full-time student. These costs ... site development, architects' fees, construction, and fixed equipment, but exclude land and movable equipment. In much of this construction, trends follow recent trends in industry toward the adoption of modular patterns and the elimination of interior bearing walls, to allow maximum flexibility for adaptation to changing technological requirements.

Reliable data on costs of operation and maintenance of vocational education facilities are not available.

Area vocational schools, as public institutions with a broad educa... mission, do not, in general, charge users for their services. ...ult courses are conducted on a fee basis, but such fees cover, at most, a very small proportion of the cost of maintenance and ... n. With very minor exceptions, current expenses of these schools, like those of other public schools, are met from tax revenues.[3]

C. Trends of Capital Outlays

Until passage of the Vocational Education Act of 1963, all funds for construction of vocational school facilities were obtained from local or State sources. However, historical information regarding capital outlays is not available.

In fiscal year 1965, Federal matching funds for construction of area vocational schools became available for the first time; and in that year, a total of nearly $86 million (approximately one-half Federal) ... expended or allocated for those 208 area school construction projects which have been discussed in an earlier section.

D. Needs and Prospective Capital Outlays: 1966–75

(a) *Capital Requirements*

Preceding sections of this chapter have presented—as far as possible, based on State reports—a separate accounting of facilities for area vocational schools, because these schools exemplify an emerging concept of special interest. It has been made clear, however, that these facilities cannot be clearly separated from facilities covered in chapters on public elementary and secondary schools and on institutions for higher education. In part, this is because many facilities are shared by different types of educational programs, in part because present accounting procedures do not make the necessary distinctions.

Arrangements are now underway to collect more comprehensive statistical information about vocational programs. At present, however, it is not possible to project future needs for area vocational schools, as such, nor to distinguish between vocational needs and needs projected in other chapters of this report. Specific problems are the following:

(1) The extent to which the increase in vocational students will be accommodated in area schools is unknown. This will depend largely on State policies with respect to the designation of such schools and may vary greatly among States.

(2) The precise distribution of area school students between secondary and postsecondary schools or colleges is unknown and the future

[3] Federal, State, and local expenditures for vocational education, excluding programs funded under the Manpower Development and Training Act, are shown in app. A. Area vocational schools, of course, constitute only a small part of the total activities covered by these funds.

distribution cannot be predicted on the basis of information available.

(3) There is no adequate basis for predicting the facilities which be required for adult programs, over and above those prograr will be accommodated by the extra-shift operation of facilitie included in projections of needs for full-time students covered chapters.

Capital outlay requirements for all vocational-technical e facilities during the decade 1966–75 have been estimated at mately 2,860,000 student work stations. This is based on the tion of a very sharp increase in vocational student enrollments about 5.4 million in 1965 to about 14 million in 1975. It is assumed that the schools will operate three shifts—two during the day and in the evening. Hence, each station will serve three students. predicted growth will reflect both an increase in the proportion regular secondary and postsecondary students in vocational p and also a great expansion of adult programs, serving both those are unemployed or underemployed and those who will need n because of changes in the job market.

At current estimated facility costs of about $1,850 per work the capital outlay required to meet those projected needs would approximately $5.3 billion. However, the recent trend in cost vocational facilities shows an increase of at least 3 percent per If this trend continues, the average cost during the decade w be the neighborhood of $2,200 per work station. At this level, capital outlay will approximate $6.3 billion.

(b) *Distribution of Needs by Population Size of Community*

There is no adequate basis for estimating this distribution.

(c) *Spending Agencies for Capital Outlays*

It is anticipated that all projected outlays will be expended local public bodies.

APPENDIX A.—*Expenditures of Federal, State, and local funds for vocational education, by year, 1945–65* [1]

[In thousands of dollars]

Year	Total [2]	Federal	State	Local
1945	65,642	20,005	15,348	30,289
1946	72,807	20,628	18,538	33,641
1947	83,252	21,087	22,180	39,985
1948	103,339	26,200	25,834	51,305
1949	115,131	26,409	30,439	58,283
1950	128,717	26,623	40,534	61,561
1951	137,354	26,685	44,208	66,462
1952	146,466	25,863	47,818	72,784
1953	145,951	25,366	52,218	68,367
1954	151,289	25,419	54,550	71,320
1955	164,761	30,351	57,591	76,819
1956	175,886	33,180	61,821	80,884
1957	190,726	37,063	67,524	86,139
1958	209,748	38,733	72,305	98,710
1959	228,315	41,399	79,534	107,381
1960	238,812	45,313	82,466	111,033
1961	254,073	48,010	89,155	116,909
1962	283,948	51,438	104,264	128,246
1963	308,900	54,582	112,685	141,633
1964	332,785	55,027	124,975	152,784
1965 [3]	588,655	146,300	175,767	266,589

[1] Does not include funds from Manpower Development and Training Act.
[2] Detail may not add to total because of rounding.
[3] Estimate based on reports received to date.

CHAPTER 19

Academic Facilities for Higher Education*

A. NATURE AND COMPOSITION

1. DESCRIPTION OF FACILITIES

General Characteristics and Services Rendered

Institutions of higher education exist in every State in the Union in all the larger and more populous outlying areas. More than l of the entire number of approximately 2,200 institutions are e control of State governments or of cities, counties, or other ·ions of States. Twelve are controlled by the Federal Govern- The remaining 64 percent are controlled by religious sects, · tions within one professional group or another, or self-per- g groups of public-spirited persons.

These institutions present the widest range imaginable in type of ··on offered. Junior colleges typically provide only the first years of training at the post-secondary level, usually including courses creditable toward a baccalaureate degree and courses · ·ng terminal vocational programs. Universities commonly · addition to a full undergraduate course in liberal arts, graduate ·ding to the doctorate, as well as courses preparing for entrance at least two or three of the learned professions. Between these extremes fall the hundreds of institutions which reflect a very ectrum of general and special educational needs and purposes.

TABLE 1.—*The American higher education establishment, 1963* [1]

	Public institutions		Private institutions		All institutions	
	Number of institutions	Enrollment [2]	Number of institutions	Enrollment [2]	Number of institutions	Enrollment [2]
		Thousands		*Thousands*		*Thousands*
	88	1,188	58	558	146	1,746
colleges	101	459	684	768	785	1,227
leges	159	396	27	13	186	409
l schools [3]	26	55	31	75	57	130
eology and religion [3]			201	46	201	46
t [3]	2	1	44	18	46	19
sional schools [3]	8	10	71	58	79	68
es	360	548	217	74	577	622
Total	744	2,657	1,333	1,610	2,077	4,267

[1] By fall 1965, the number of institutions had increased to 2,207, of which 1,417 were privately controlled.
[2] Enrollments are *resident* degree-credit enrollment and hence do not correspond precisely to data presented this chapter.
[3] These categories include only the independent professional schools. Many students in professional) of course included in university enrollments.

Source: Resident and Extension Enrollment in Institutions of Higher Education, Fall 1963 (OE 54000-63).

*This chapter has been prepared by Dr. E. Eugene Higgins, of the National Center for Educational Statistics, and Dr. Kent Halstead, of the Bureau of Higher Education, U.S. Office of Education, Department of Health, Education, and Welfare, with minor editing by committee staff.

TABLE 2.—*Institutions and proportionate enrollments, by size of student body*

Size of student body [1]	Number of institutions			Percent of all institutions	Percent of all enrollments
	Public	Private	Total		
Less than 200	55	287	342	16.5	
200 to 499	122	318	440	21.2	
500 to 999	129	347	476	22.9	
1,000 to 2,499	156	271	427	20.5	
2,500 to 4,999	137	44	181	8.7	
5,000 to 9,999	79	45	124	6.0	
10,000 to 19,999	44	17	61	2.9	
20,000 or more	22	4	26	1.3	
Total	744	1,333	2,077	100.0	

[1] Based on resident degree-credit enrollment.

Source: Resident and Extension Enrollment in Institutions of Higher Education, Fall 1963 (

Tables 1 and 2 present summary information, including en data, by type and size of institution. As table 2 shows, ins with enrollments of under 1,000 constitute about 60 percent of institutions but account for less than 15 percent of the students. contrast, those colleges and universities with enrollments of 5,000 more comprise less than 10 percent of the institutions but acc almost 60 percent of the students.

(b) *Enrollment Growth in Higher Education*

The recent rapid growth in higher education enrollment is s table 3, which summarizes data from 1946 to the present. In years immediately following World War II, public and private tions represented approximately equal segments of the total population. During the postwar period returning veterans, su by the GI bill, caused an enrollment surge in both types of tions which was followed by a brief decline in the early fifties. sequently, enrollments recovered rapidly from the low point during the Korean conflict; and in recent years there has been tinuous and accelerating growth, with the increase being largest in public sector. As a result, degree-credit enrollment in 1965 re a 168-percent increase over 1946 and is more than double the ment in 1955. Of more than 5½ million students now enrolle 65 percent are now in publicly controlled institutions, compared 50 percent in 1947. Junior college enrollments, especially in institutions, have increased even more rapidly than those in colleges and universities. In total, these have more than qua since 1946; and although the pattern of development in highe tion varies considerably from State to State and cannot be p with full confidence, there is good reason to anticipate a co trend toward increased emphasis on 2-year institutions.

—Degree-credit opening fall enrollment in higher education institutions, by level and control: Aggregate United States, 1946–65

Year	All institutions	4-year institutions			Junior colleges		
		Total	Public	Private	Total	Public	Private
-----	2, 078, 095	1, 889, 956	(1)	(1)	188, 139	(1)	(1)
-----	2, 338, 226	2, 116, 181	989, 372	1, 126, 809	222, 045	163, 005	59, 040
-----	2, 408, 249	2, 197, 067	1, 036, 266	1, 160, 801	211, 182	154, 175	57, 007
-----	2, 456, 841	2, 227, 630	1, 047, 681	1, 179, 949	229, 211	170, 899	58, 312
-----	2, 296, 592	2, 079, 020	986, 413	1, 092, 607	217, 572	168, 043	49, 529
-----	2, 116, 440	1, 916, 353	895, 661	1, 020, 692	200, 087	156, 329	43, 758
-----	2, 148, 284	1, 908, 772	921, 902	986, 870	239, 512	191, 798	47, 714
-----	2, 250, 701	1, 990, 434	992, 923	997, 511	260, 267	210, 635	49, 632
-----	2, 499, 750	2, 183, 766	1, 131, 533	1, 052, 233	315, 984	263, 693	52, 291
-----	2, 678, 623	2, 369, 647	1, 232, 619	1, 137, 028	308, 976	265, 891	43, 085
-----	2, 946, 985	2, 598, 702	1, 383, 112	1, 215, 590	348, 283	298, 559	49, 724
-----	3, 068, 417	2, 698, 454	1, 463, 489	1, 234, 965	369, 963	316, 791	53, 172
-----	3, 258, 556	2, 872, 045	1, 580, 561	1, 291, 484	386, 511	331, 671	54, 840
-----	3, 402, 297	2, 990, 802	1, 645, 946	1, 344, 856	411, 495	356, 922	54, 573
-----	3, 610, 007	3, 156, 390	1, 742, 137	1, 414, 253	453, 617	393, 553	60, 064
-----	3, 891, 230	3, 370, 227	1, 893, 423	1, 476, 804	521, 003	458, 296	62, 707
-----	4, 206, 672	3, 614, 344	2, 075, 917	1, 538, 427	592, 328	520, 987	71, 341
-----	[2] 4, 528, 516	3, 900, 710	2, 319, 521	1, 581, 189	627, 806	553, 302	74, 504
-----	[3] 4, 987, 867	4, 274, 591	2, 583, 805	1, 690, 786	713, 276	621, 978	91, 298
-----	[4] 5, 570, 271	4, 725, 027	2, 914, 660	1, 810, 367	845, 244	739, 918	105, 326

[1] Not available.
[2] Excludes 271,816 students in undergraduate programs not chiefly creditable toward a bachelor's degree.
[3] Excludes 332,427 students in undergraduate programs not chiefly creditable toward a bachelor's degree.
[4] Excludes 397,140 students in undergraduate programs not chiefly creditable toward a bachelor's degree.

NOTE.—Prior to 1953, includes *only* resident degree-credit students; in 1953 and subsequent years includes extension degree-credit students.

Academic Facilities Covered by this Report

The foregoing review of enrollment trends provides an important
for the remainder of this chapter—an analysis based primarily
the most recent comprehensive information on higher education facilities provided by an inventory conducted by the Office of Education as of December 31, 1957.[1] Institutions participating in the
y represented about 96 percent of all students enrolled, and the results thus provided a wealth of detailed information relating to
the entire establishment in existence at that time. In the
years, however, construction required to meet the needs of a more than 80-percent increase in the number of students has made this
y substantially out of date as a census report, although its norms of experience or practice are still useful. A new inventory will be made as of September 30, 1965, and will be updated annually; but since only crude updating of the 1957 data is possible now, the 1957 inventory necessarily provides the basis for most of the information to
presented here.

Academic facilities will be defined to include all those which have
classified under three major categories, designated "instruc-
" "research," and "general." They thus exclude the "auxiliary" and "residential" facilities which are covered in another chapter.
4, 5, and 6 show the composition of these categories. Percentages in these tables are based on assignable area [2]; that is, on the total area which could be explicitly allocated by function. Elsewhere
this chapter, facilities are generally reported in terms of gross square feet, because the latter is more appropriate for cost estimates and for a

[1] Higgins, E. Eugene, *and* Mary B. Fuller. *College and University Facilities Survey, Part 3: Inventory of College and University Physical Facilities, December 31, 1957.* U.S. Department of Health, Education, and
ce of Education (OE-51007). Washington: U.S. Government Printing Office, 1965. 573 pages.
[2] Such areas were reported in net square feet, defined as the area of a space measured from the inside walls
, ignoring minor architectural projections or setbacks.

number of other purposes. When facilities are to be separated by function, however, gross area data are inappropriate because they are obtained from outside building measurements and are thus available only for buildings which usually serve several functions.

TABLE 4.—*Percentage distribution of total assignable area [1] for instructional by function and control—Aggregate United States*

Function	Public	Private
Instructional facilities category	100.00	
Educational laboratory schools	4.85	
General or academic classrooms	25.07	
Home management laboratory houses	.38	
Instructional laboratories and shops	31.77	
Library	13.68	
Museum	.88	1.01
Other instructional	1.48	
Physical education [2]	18.08	20.25
*Teaching hospital	3.81	

[1] Exclusive of areas for which function was not reported; exclusive of detail areas of buildings for which total assignable area only was reported; exclusive of buildings shared with institutions of less grade.

[2] Includes fieldhouses, gymnasiums, swimming pools, and enclosed areas of stadiums *when* serving the physical education programs; includes spectator seating area in fieldhouses and gymnasiums.

TABLE 5.—*Percentage distribution of total assignable area [1] for research fac function and control—Aggregate United States*

Function	Public	Private
Research facilities category	100.00	
Agriculture	33.20	
Astronomy	.21	
Biology	6.54	
Chemistry	6.47	
*Dentistry	.31	
Engineering	11.55	
Mathematics and statistics	.33	
*Medicine	10.18	
Not identified	23.68	
Other physical sciences	2.06	
Physics	3.88	
Social sciences	1.59	

[1] See footnote 1 for table 4.

TABLE 6.—*Percentage distribution of total assignable area [1] for general by function and control—Aggregate United States*

Function	Public	Private
General facilities category	100.00	
Armories	1.34	
Auditoriums	8.16	
Chapels	.35	
Extension service and experiment stations	.87	(2)
Faculty clubs and facilities	.36	
Faculty offices	24.32	
Garages	2.61	
General storage	7.28	
Maintenance shops, stores, and services	11.04	
Multipurpose	8.10	
*Nonteaching hospitals	.69	
Other general	11.03	
Power and heating plants	4.61	
Staff offices	18.22	
Theaters	.97	

[1] See footnote 1 for table 4.

[2] Less than 0.05 percent.

The totals of assignable areas (net square feet) represented in tables 5, and 6 are as follows:

	Control of institution		
	Public	Private	Total
	97, 394, 000	68, 216, 100	165, 610, 100
	12, 484, 800	6, 271, 800	18, 756, 600
	53, 854, 500	38, 537, 400	92, 391, 900
Total	163, 733, 300	113, 025, 300	276, 758, 600

Attention should be called to the fact that a small part of the facili- included above and elsewhere in this report overlap with those ı other chapters of this study. These are the hospital facili- appearing in tables 4 and 6, and the medical and dental research appearing in table 5 (identified by asterisks). It has not feasible to eliminate these facilities from subsequent detailed ns, but the total overlap can be closely estimated, to provide basis for adjusting national totals. The estimates follow:

	Percent
itutions	3. 30
titutions	5. 11
ions	4. 04

Standards for Academic Facilities

Data already presented give some indication of the tremendous in types of facilities used in higher education. There are, in such large variations among regions and among institutions of types and sizes that only the most general statements can made about requirements for educational adequacy based upon s of experience or practice. Some further indications of this are provided by tables 7, 8, and 9. Table 7 shows, for types of institutions, the assignable area per student in each the three major facilities categories, and in total. The other two esent data on "student capacity" for selected types of facili- Explicitly, they express the number of seats or student stations tages of total enrollment and thus provide some evidence on n of these facilities. Such data, however, must be in- with great caution, and only in the context of detailed in- ı about scheduling problems, multiuse possibilities, and other pertaining to the specific institution under consideration. 10 indicates that there are substantial "economies of scale" for ıal institutions which enroll large numbers of students, but increasing criticism of some of our large universities for their ality and "factory like" atmosphere suggests that some of nomies may be purchased at a higher cost than has sometimes ized.

The average area of academic facilities per student (full time and time) at all institutions of higher education in 1957 was approxi- 135 gross square feet, and this average has probably sub- r declined, as the institutions have struggled to meet the ented demand of the last few years. Although it is evident in the final analysis, needs for facilities must be determined for institution individually, a number of States have adopted, for purposes, a standard of 150 square feet per student; and

this figure has recently been used by the Office of Education as basis for estimates of aggregate demand.

TABLE 7.—*Area per student in major facilities categories at institutions of types (based on data from 1957 facilities inventory)*

	Public institutions assignable area [1] per student (in square feet)				Private institutions assignable area [1] per student (in square feet)	
	Instructional [2]	Research [2]	General [2]	Total	Instructional [2]	Research [2]
Universities	60.7	13.8	41.2	115.7	43.1	9.1
Liberal arts colleges	49.2	1.4	23.5	74.1	66.7	1.2
Teachers colleges	65.6	.6	27.3	91.5	47.1	1.2
Technological schools	98.7	4.1	42.2	145.0	52.1	7.2
Theological and religious schools					75.3	1.8
Other independent professional schools	143.1	25.3	96.6	265.0	73.3	12.9
Junior colleges and technical institutes	34.2	.2	9.9	44.3	70.5	.4
All institutions [3]	56.4	7.2	31.2	94.8	56.7	5.2
Percent of all academic facilities	59.5	7.6	32.9	100.0	60.4	5.5

[1] Assignable area, rather than gross area, was used for this breakdown, because gross are from outside measurements of buildings, and many buildings serve multiple functions. O area assignable to specific functions contributes about 70 percent of gross area, but this propo to substantial variation.

[2] See text (p. 377) for definition of these categories.

[3] Figures for "all institutions" represent weighted averages, to which certain types of in tribute negligible amounts. Although the "mix" of institutions has probably changed since 1957, data in table 1 provide a general indication of the mix on which these averages were based.

TABLE 8.—*Percentage of fall 1957 enrollment that could have been ac at one time [1] by selected instructional facilities, by type of institution— United States*

Type of institution	Academic classrooms		Instructional laboratories		Libraries
	Public	Private	Public	Private	Public
All types	83.3	93.8	35.8	30.0	10.4
University	94.4	75.5	39.7	24.5	1
Liberal arts college	71.2	109.7	31.7	34.2	1
Teachers college	87.0	74.2	33.0	22.4	1
Independent technological school	89.3	72.6	48.1	36.4	
Theological and religious school		119.9		10.4	
Other independent professional school	131.9	80.8	67.0	36.6	1
Junior college	59.5	122.9	28.2	33.1	
Technical institute	67.2	73.1	73.5	50.5	

[1] Exclusive of educational laboratory or demonstration schools.

TABLE 9.—*Percentage of fall 1957 enrollment that could have been ac at one time [1] by selected instructional facilities, by enrollment group— United States*

Enrollment group	Academic classrooms		Instructional laboratories		Libraries
	Public	Private	Public	Private	Public
All groups	83.3	93.8	35.8	30.0	10.4
Below 500	148.4	135.9	61.6	40.4	2
500 to 999	102.8	122.4	49.7	40.2	1
1,000 to 2,499	91.6	100.9	39.0	33.6	1
2,500 to 4,999	83.5	82.6	40.4	24.7	1
5,000 to 9,999	74.1	73.1	32.3	22.3	1
10,000 and more	76.8	62.8	29.5	22.0	1

[1] Exclusive of educational laboratory or demonstration schools.

2. EXISTING CAPITAL PLANT FOR HIGHER EDUCATION

Distribution

Colleges and universities in the aggregate United States reported
00 square feet of gross area in their instructional, research,
general facilities categories of buildings at the end of 1957.
ns were requested not to report those buildings that were
on remote institutional properties that were not used for
nal purposes, or which were used by relatively small portions
ident body for only a short period of time each year, such as
it stations, observatories, field camps, farms, ranches, and
it properties; hospitals not owned by the institution even
some limited research and/or instruction may be carried on
them; and public schools, not owned by the institution, which are
practice teaching.

Gross area is defined as the sum of the areas at each floor level
within the principal outside faces of exterior walls, neglecting
ural setbacks or projections. All stories or spaces which have
aces with clear standing headroom (6 feet, 6 inch minimum)
which are being used or can be adapted for use are included.
area, therefore, consists of assignable areas (areas having func-
as adopted for the study) plus unassignable areas (restrooms,
, stairs, wall and partition thicknesses, and the like).

The gross areas for instructional, research, and general facilities
s are presented in table 10 by region, State, and type of
or the aggregate United States. It should be noted that as
the date of the survey Alaska and Hawaii were considered outlying
Also, it should be pointed out that the Canal Zone, Guam,
three of the U.S. service schools did not participate in the study.

A comparison of data in table 10 with information relating to
e area presented in table 7 reveals significant differences in the
proportions of facilities included in the major categories.
erences result from the fact that gross areas were categorized
the basis of primary function of each building, as reported by each
n. It turns out that gross area data substantially exaggerate
proportion of space devoted to research and greatly understate
proportion given to general uses. In table 10 and in subsequent
therefore, attention should be directed mainly to the total
as evidence of the distribution of all academic facilities,
s of specific function.

Information on the distribution of facilities by population size of
not available.

Age and Condition of Academic Facilities

Table 11 summarizes regional data which show the period of initial
y of facilities existing in 1957. It should be noted that in
period immediately following World War II, occupancy was not
y a reliable indicator of the actual age of buildings. This is
many of the buildings first occupied by educational institu-
during the years 1946 through 1948 were actually war surplus
converted to temporary educational use. In general, how-
it may be assumed that age and period of occupancy coincide.

TABLE 10.—*Gross areas of instructional, research, and general facilities categories of buildings,[1] by region, State, category, and control—Aggregate United States*

[Area in hundreds of square feet]

Region and State	Public				Private			
	Total	Instructional	Research	General	Total	Instructional	Research	General
Aggregate United States	2,338,088	1,680,922	414,049	243,117	1,532,023	1,155,913	209,983	166,127
Northeast	269,114	205,179	41,696	22,239	635,069	443,059	128,639	63,371
Connecticut	15,044	11,034	2,244	1,766	46,938	35,911	4,785	6,242
Maine	16,102	14,472	927	703	8,069	6,718	633	718
Massachusetts	24,309	16,664	5,814	1,831	147,590	95,977	35,876	15,737
New Hampshire	8,143	6,346	527	1,270	9,744	7,853	871	1,020
New Jersey	22,956	17,289	3,606	2,061	33,441	20,370	8,216	4,855
New York	123,308	90,865	23,818	8,625	202,408	141,560	42,523	18,325
Pennsylvania	47,273	39,321	2,150	5,802	167,140	120,090	33,933	13,117
Rhode Island	5,935	4,140	1,614	181	13,677	9,976	1,802	1,899
Vermont	6,044	5,048	996		6,062	4,604		1,458
North Central	777,685	519,271	174,804	83,610	400,462	323,379	39,612	37,471
Illinois	97,745	54,765	31,210	11,770	113,947	86,676	18,543	8,728
Indiana	71,479	44,147	19,986	7,346	42,940	38,283	241	4,416
Iowa	51,018	33,240	14,420	3,358	27,199	23,578		3,621
Kansas	56,757	43,761	7,592	5,404	14,479	13,591		888
Michigan	147,679	92,627	39,732	15,320	25,432	22,631	1,555	1,246
Minnesota	80,670	49,261	18,359	13,050	21,428	18,674		2,754
Missouri	39,265	32,978	3,810	2,477	52,443	36,078	12,181	4,184
Nebraska	36,371	30,401	2,835	3,135	11,401	10,295	465	641
North Dakota	21,218	15,086	4,098	2,034	745	654		91
Ohio	99,948	71,429	16,222	12,297	61,916	50,636	3,355	7,925
South Dakota	16,927	10,574	3,231	3,122	4,664	3,911	541	212
Wisconsin	58,608	41,002	13,309	4,297	23,868	18,372	2,731	2,765

South	751,900	551,071	116,283	84,546	357,707	278,002	31,942	47,763
Alabama	42,537	33,862	1,419	7,256	15,356	12,820	313	2,223
Arkansas	32,487	22,805	6,588	3,094	7,317	6,692	76	549
Delaware	6,501	6,071	30	400	90	90		
Florida	35,945	25,826	5,346	4,773	19,347	14,696	302	4,349
Georgia	49,230	37,389	7,682	4,159	29,213	20,202	3,622	5,389
Kentucky	36,667	25,806	5,003	5,858	13,749	12,725		1,024
Louisiana	51,771	38,730	7,835	5,206	19,258	17,024	565	1,669
Maryland	34,746	18,734	12,471	3,541	23,910	16,204	4,456	3,250
Mississippi	32,952	26,332	2,224	4,396	6,156	5,487	83	586
North Carolina	66,735	45,553	13,622	7,560	44,607	30,265	9,940	4,402
Oklahoma	54,923	42,574	5,774	6,575	11,680	9,461		2,219
South Carolina	40,178	20,571	16,423	3,184	12,785	11,529	61	1,195
Tennessee	40,341	31,930	3,644	4,767	39,095	30,704	5,885	2,506
Texas	129,977	95,953	17,398	16,626	62,619	50,351	1,549	10,719
Virginia	53,006	42,164	7,721	3,121	23,462	19,972	40	3,450
West Virginia	29,030	24,291	3,092	1,647	5,465	4,978		487
District of Columbia	14,874	12,480	11	2,383	23,598	14,802	5,050	3,746
West	507,713	383,319	78,871	45,523	137,416	110,276	9,790	17,350
Arizona	20,730	12,145	6,240	2,345	1,086	819		267
California	237,823	171,588	44,963	21,272	82,495	63,843	9,098	9,554
Colorado	40,288	36,205	1,841	4,242	14,627	10,388	333	3,906
Idaho	17,980	15,454	740	1,786	1,773	1,650		123
Montana	16,960	15,018	1,116	826	1,376	1,318		58
Nevada	3,906	3,008	689	209				
NewMexico	22,158	15,855	3,091	3,212	918	553		365
Oregon	46,960	37,832	5,462	3,666	11,280	9,947	234	1,099
Utah	27,318	19,173	5,651	2,494	9,207	8,401	125	681
Washington	60,618	47,681	8,825	4,112	14,654	13,357		1,297
Wyoming	10,972	9,360	253	1,359				
U.S. service schools	10,815	5,989	751	4,075				
Outlying parts	20,861	16,093	1,644	3,124	1,369	1,197		172
Alaska	1,371	999	176	196				
Canal Zone								
Guam								
Hawaii	8,273	7,051	756	466	217	217		
Puerto Rico	11,217	8,043	712	2,462	1,152	980		172

[1] Exclusive of buildings shared with institutions of less than college grade.

Source: *College and university facilities survey*, table 11.

TABLE 11.—*Gross areas of instructional, research, and general facilities categories of buildings,*[1] *by region, category, period of initial occupancy, and control: Aggregate United States*

[Area in hundreds of square feet]

Region and facilities category	Public				Private			
	Through 1899	1900–1919	1920–39	1940–57	Through 1899	1900–1919	1920–39	1940–57
Aggregate United States	139,262	424,741	752,632	1,009,108	218,936	301,806	493,898	512,649
Instructional [2]	108,235	306,126	567,025	696,181	173,809	225,894	365,539	387,309
Research [3]	15,516	78,429	117,985	197,626	20,148	43,904	80,495	65,270
General [4]	15,511	40,186	67,622	115,301	24,979	32,008	47,864	60,070
Northeast	30,817	54,665	90,272	92,626	107,538	141,430	213,309	170,855
Instructional	25,179	40,832	72,732	65,933	80,487	91,614	152,372	116,940
Research	2,707	7,497	10,587	20,905	13,891	36,798	41,988	35,962
General	2,931	6,336	6,953	5,788	13,160	13,018	18,949	17,953
North central	63,326	209,748	228,781	272,752	62,124	84,860	129,163	123,365
Instructional	49,831	141,173	154,619	173,571	52,498	71,803	101,446	96,949
Research	7,880	50,367	51,370	65,187	2,445	3,681	18,994	14,492
General	5,615	18,208	22,792	33,994	7,181	9,376	8,723	11,924

South	25,785	92,718	270,749	359,248	29,425	57,673	109,825	158,937
Instructional	17,783	71,269	206,510	254,255	24,898	48,636	78,480	124,955
Research	2,849	11,057	37,711	63,565	935	2,528	17,694	10,619
General	5,153	10,392	26,528	41,428	3,592	6,509	13,651	23,363
West	18,525	66,681	154,789	264,083	19,632	17,843	41,388	58,553
Instructional	14,759	52,425	127,626	188,486	15,709	13,841	33,028	47,698
Research	2,080	9,508	17,468	46,423	2,877	897	1,819	4,197
General	1,686	4,748	9,695	29,174	1,046	3,105	6,541	6,658
U.S. service schools	809	72	115	9,819				
Instructional	683			5,306				
Research				751				
General	126	72	115	3,762				
Outlying parts		857	7,926	10,580	217		213	939
Instructional		427	5,538	8,630	217		213	767
Research			849	795				
General		430	1,539	1,155				172

[1] Exclusive of buildings shared with institutions of less than college grade.
[2] Exclusive of area of buildings for which year of initial occupancy was not reported (public, 3,355; private, 3,362).
[3] Exclusive of area of buildings for which year of initial occupancy was not reported (public, 4,493; private, 166).
[4] Exclusive of area of buildings for which year of initial occupancy was not reported (public, 4,497; private, 1,206).

In the 1957 inventory, institutions were asked to report the condition of buildings in one of three categories:

1. Satisfactory;
2. Needs major rehabilitation now;
3. Should be razed now, but need for space and lack of money for replacement force continued use.

Table 12, which summarizes results of this query, reveals that about one-sixth of all academic facilities either required major rehabilitation or should have been retired from use at the time of the inventory.

(c) *Control of Higher Education Facilities*

Except for the distinction between public and private institutions, which has been maintained throughout this chapter, reliable information on the proportions of facilities under different types of control is not available. Based on the most recent data, the distribution of institutions of higher education among the various control categories is as follows: [3]

	institutions
State governments or agencies	424
Cities, counties, special districts, etc	354
Private nonprofit organizations	1,385
Proprietary organizations	32
Federal Government	12
Total	2,207

However, the additional data, such as enrollments, which would permit estimates of the distribution of facilities, have not been aggregated by these categories.

TABLE 12.—*Gross areas of instructional, research, and general facilities categories of buildings,[1] by region, condition, category, and control: Aggregate United States*

[Area in hundreds of square feet]

Region and condition	Public				Private			
	Total	Instructional	Research	General	Total	Instructional	Research	General
Aggregate United States	2,338,088	1,680,922	414,049	243,117	1,532,023	1,155,913	209,983	166,127
Condition 1	1,936,466	1,396,491	349,936	190,039	1,310,531	987,615	185,499	137,417
Condition 2	221,419	162,889	40,143	18,387	140,287	103,730	22,098	14,459
Condition 3	176,754	119,007	23,179	34,568	77,608	61,890	2,288	13,430
Not reported	3,449	2,535	791	123	3,597	2,678	98	821
Northeast	269,114	205,179	41,696	22,239	635,069	443,059	128,639	63,371
Condition 1	232,998	175,012	37,590	20,396	569,069	395,913	117,264	55,892
Condition 2	21,721	18,008	3,132	581	43,146	29,417	9,833	3,896
Condition 3	14,395	12,159	974	1,262	22,374	17,249	1,542	3,583
Not reported					480	480		
North Central	777,685	519,271	174,804	83,610	400,462	323,379	39,612	37,471
Condition 1	610,730	405,940	139,935	64,855	324,986	265,662	30,962	28,362
Condition 2	94,763	64,692	23,560	6,511	46,396	33,582	8,278	4,536
Condition 3	71,314	47,957	11,113	12,244	27,026	22,617	372	4,037
Not reported	878	682	196		2,054	1,518		536

See footnote at end of table.

[3] See *Education Directory, 1965–66; Part 3, Higher Education;* U.S. Office of Education, 1966. Institutions with less than 4-year programs constitute the great majority of those controlled by cities, counties, and special districts, and a substantial majority of those under proprietary control.

12,—*Gross areas of instructional, research, and general facilities categories of by region, condition, category, and control: Aggregate United States*—Con.

Region and condition	Public				Private			
	Total	Instructional	Research	General	Total	Instructional	Research	General
South	751,900	551,071	116,283	84,546	357,707	278,002	31,942	47,763
	644,085	474,817	103,302	65,966	304,248	233,371	31,352	39,525
	62,289	46,316	8,329	7,644	31,142	27,611	220	3,311
	43,631	28,671	4,057	10,903	21,274	16,360	272	4,642
	1,895	1,267	595	33	1,043	660	98	285
West	507,713	383,319	78,871	45,523	137,416	110,276	9,790	17,350
	422,111	323,007	66,992	32,112	111,076	91,689	5,921	13,466
	39,836	31,632	4,844	3,360	19,386	12,903	3,767	2,716
	45,090	28,094	7,035	9,961	6,934	5,664	102	1,168
	676	586		90	20	20		
U.S. service schools	10,815	5,989	751	4,075				
	8,897	4,459	751	3,687				
	1,703	1,513		190				
	215	17		198				
Outlying parts	20,861	16,093	1,644	3,124	1,369	1,197		172
	17,645	13,256	1,366	3,023	1,152	980		172
	1,107	728	278	101	217	217		
	2,109	2,109						

[1] Exclusive of buildings shared with institutions of less than college grade.

(d) *Estimated Value of Facilities*

The value of academic facilities existing in 1965 has been estimated based on the following:

1. 1957 values, as reported by the institutions which participated in the inventory.

2. 1958–60. Institutional reports of capital outlay for new academic facilities. (One-half of the outlay for the fiscal year 1958–59 was added as the assumed cost of construction during the 6 months between the inventory and the first fiscal year covered by these reports.)[4]

3. 1961–65. Estimated outlays, based on reports to the Office of Education which indicate a general continuation of the steadily increasing effort put forth by the institutions during the preceding 5 years. Estimated increases were 12 percent annually through 1964 and 10 percent for 1965.

All values and costs were adjusted upward to take account of non-ng institutions. Then, based on experience data, values increased by 3.25 percent per year as an allowance for rising tion costs. They were decreased by 2 percent per year to depreciation.

[4] See the following:

W. Robert and Leslie F. Robbins. *Progress in the Construction of Higher Education Facilities, 1951–59.* U.S. Department of Health, Education, and Welfare, Office of Education (OE-51002). Washington: U.S. Government Printing Office, 1962. pp. 1, 14.

. *New Construction and Rehabilitation on College Campuses, 1959–60 and 1960–61.* U.S. Department of Health, Education, and Welfare, Office of Education (OE-51002-61). Washington: U.S. Government Printing Office, 1963. pp. 1, 9, 11, 19.

Results of these estimates and computations are summarized below:

[Thousands of dollars]

Period of construction	Institutional control		
	Public	Private	Total
Through 1957	3, 594, 920	3, 054, 570	6, 649, 490
Jan. 1 to June 30, 1958	125, 928	70, 237	196, 165
Fiscal years 1959–61	893, 735	503, 768	1, 397, 503
Fiscal years 1962–65	1, 894, 038	974, 430	2, 868, 468
Total	6, 508, 621	4, 603, 005	11, 111, 626

Precise information on additions to academic facilities 1 from the large outlays of the past few years is not available. Estimates place net additions during this period at about 230 million gross square feet, indicating that the aggregate facilities now in use exceed 600 million gross square feet.

B. Costs and User Charges

1. CONSTRUCTION COSTS AND OPERATING COSTS

(a) *Construction Costs*

Average costs in 1964–65 for several different types of academic facilities are shown below. These costs are per gross square foot, including land, buildings, fixed and movable equipment, and improvements such as utilities and landscaping. Figures in parentheses in the first column indicate the number of projects included in the average. The third column shows the cost range within which the majority (i.e., 65–70 percent) of the projects fell.

Facility function	Mean cost	1 standard deviation range
Library (124)	$25. 48	$19. 16–$31. 80
Library and classroom (47)	23. 44	17. 19– 29. 69
Library and sciences (11)	27. 00	20. 38– 33. 62
Classroom and science (25)	26. 87	17. 80– 35. 95
Science (150)	28. 24	19. 75– 36. 73
General classroom (37)	27. 14	20. 67– 33. 42
Weighted average	26. 57	

Based on the data above, the typical cost used currently for budgeting purposes is $27.50 per gross square foot.

(b) *Costs of Maintenance and Operations*

In academic year 1957–58 all institutions of higher education spent $408,938,467 for operating and maintenance of their physical plant. Included in this amount are salaries, wages, supplies, other expenses, and equipment for operation and maintenance of the insti plant, excluding those appropriately chargeable to auxiliary enter-

and organized activities relating to educational departments. In 1957–58 the total gross area of academic facilities in the United States was approximately 387,011,100 gross square feet. Unit ance cost in 1958 was therefore approximately $1.06 per square foot per year. To update this cost to 1964–65, a 3.6 annual rate of increase is used which represents the rate of in salaries for the skilled maintenance trades and unskilled rkers. For 1964–65 the derived unit maintenance costs equal per gross square foot per year.

2. USER CHARGES

In higher education, user charges are principally tuition and fees against students for educational and general purposes. No proportion of this student income is designated for educational as opposed to maintenance and operation expenses. User expressed as a percentage of current educational expenditures both educational services and plant operation and maintenare indicated below.

	1959–60	1961–62
	In millions	*In millions*
General administration	$587	$736
Instruction and departmental research	$1,803	$2,216
Library	$136	$178
Subtotal	$2,526	$3,130
and operation of the physical plant	$474	$566
Total	$3,000	$3,696
	$1,196	$1,547
as a percent of total	39.9	41.9

Since colleges and universities are continually expanding, their expenditure burden is best represented by the total of debt it and new construction expenditure. A very small comf student tuition and fee income is restricted for plant expanand debt retirement, but, as shown below, this component ly a trivial part of the total burden.

	1959–60	1961–62
	In millions	*In millions*
capital indebtedness and interest	$176	$262
	$1,197	$1,555
Total	$1,373	$1,817
restricted for these purposes)	$15	$23
ident fees as percent of total	1.1	1.3

The extent to which the cost of higher education facilities is met eral tax resources and general obligation borrowings of State local government units is indicated in the next section. (See 14, lines 2, 3, 5, and 6.)

C. Trends of Capital Outlays

The most reliable estimates of capital outlay for academic now available cover only the period since the 1957 facilities inventory. These estimates, together with estimates of the area added to each year, appear in table 13.

Of these annual capital outlays the distribution by spending agency has been estimated for 2 recent years, as follows:

[In percent]

	1963–64	1964–65
Public institutions	67.7	
Private insitutions	32.3	
Total	100.0	

Information on sources of financing for capital outlay is sum in table 14. The following notes provide references to items in table which relate to specific items of information requested by committee:

(*a*) Appropriations from tax resources—lines 1, 2, and 3.
(*g*) Gifts, bequests, donations, etc.—line 8.
(*c*) Federal Government grant assistance [1]—line 1.
(*d*) State grants-in-aid (all States)—line 2.
(e) Tax exempt municipal bond market—lines 4, 5, 6, and (public institutions only).
(*f*) Capital flotations in other security markets—lines 4, 5, and 7 (private insitutions only).
(*g*) Borrowing from Federal Government—line 4.

Table 13.—*Estimated capital outlay*

[In millions of dollars]

Year	Total	Breakdown of total		Breakdown of total
		Public	Private	Federal
1959–60	613	412	201	
1960–61	628	387	241	
1961–62	715	455	260	
1962–63	788	515	273	
1963–64	882	597	285	
1964–65	1,352	829	523	382
1965–66	1,701	1,000	701	634

TABLE 14.—*Estimated percentage distribution of funds by source for new academic construction and rehabilitation completed by higher education institutions*

	Public institutions			Private institutions		
	1960–61	1963–64	Estimate [1] 1964–65	1960–61	1963–64	Estimate [1] 1964–65
Appropriations and grant income from public sources	60.5	51.5	61.3	8.4	11.1	28.0
1. Federal Government	3.4	5.3	25.1	7.2	8.7	26.5
2. State government	54.3	43.9	34.4	1.2	1.1	.5
3. Local government	3.0	2.3	1.8	----------	1.3	.8
Loans for plant funds from general obligation or revenue—bonds, mortgages, bank loans, notes, etc., issued by	30.1	37.3	29.9	14.6	12.0	24.9
4. Federal Government	----------	----------	.7	----------	----------	17.6
5. State government and state authority	12.9	16.3	12.8	1.9	----------	----------
6. Local government	6.3	3.5	2.7	----------	----------	----------
7. Institutions of higher education	10.9	17.5	13.7	12.7	12.0	7.3
Other funds	9.2	11.2	8.8	77.0	76.9	47.1
8. Gifts and grants from private sources	6.6	4.3	3.4	54.0	60.5	37.0
9. Loans from other institutional funds	.6	2.2	1.7	5.7	9.1	5.6
10. Transfers from other institutional funds	1.2	3.2	2.5	12.4	4.6	2.8
11. All other sources	.8	1.5	1.2	4.9	2.7	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
Estimated capital outlay (in millions)	$387	$597	$829	$241	$285	$523

[1] Estimated values are based on the assumption that the source mix percentages for all incomes other than Federal funds administered under titles I, II, and III, HEFA, will remain the same as the 1963–64 distribution.

D. NEEDS AND PROSPECTIVE CAPITAL OUTLAYS: 1966–75

(a) *Capital Requirements*

Facility needs for higher education in the decade 1966–75 have been estimated as follows:

	Million gross square feet
Backlog of unmet needs	133
Facilities required for new enrollment	561
Rehabilitation, estimated at 7.5 percent of requirements for new enrollment. Hence, equivalent to	42
Total requirement for decade	736

At estimated building and equipment costs of $27 per square foot for fiscal year 1965, the capital outlay requirements for the decade 1966–75 would be slightly under $20 billion. However, since recent experience indicates a rise in construction costs of at least 3.25 percent annually, it is prudent to assume that the average cost of facilities to be constructed during the decade will be at least $32 per square foot. At this cost, the required capital outlay will be approximately $23.5 billion.

The estimated requirement for rehabilitation included above is based on information showing that new construction and rehabilitation typically account for about 93 percent and 7 percent respectively of facility expenditures.

Other assumptions in this estimate are:

(1) That the allowance of 150 gross square feet per student will be adequate to meet future educational needs.

(2) That enrollments will increase during the decade by an average of slightly over 5 percent per year, leading to a total enrollment in fiscal year 1975 of approximately 8.7 million students.

As far as space is concerned, the per student allowance will probably be adequate. It should be noted, however, that the need to educate students for a world of increasingly complex technology, together with changes in educational technology itself, are expected to add very rapidly to the demands for costly equipment in higher education. This allowance, therefore, translated into dollar equivalents, is probably quite modest.

Capital outlay requirements will be very sensitive to changes in enrollments. Hence, the uncertainty of the enrollment e used here should be emphasized. Specifically, it should be that enrollment projections make no allowance for the effect of the Veterans' Readjustment Benefit Act of 1966, nor do they take into account the growing belief that the education of most students should be extended at least 2 years beyond high school graduation. The projection does imply an increasing ratio of college enr to "college-age" (18–24) population, as shown below:

	Percent		
1960	22	1970	
1965	25	1975	

Whether the estimated increase will be sufficient to reflect rising demand for higher education is a matter of judgment. Even small changes in the ratio will have substantial effects, because the population in this age group is large. To be explicit, an increase in 1975 ratio of only 2 percentage points (from 33 to 35 percent) would require an upward adjustment in the projected enrollment of more than half a million students. At construction costs estim 1975, such an increase would mean an added capital outlay requirement of approximately $3 billion.[5]

(b) *Distribution of Needs by Population Size of Community*

The proportions of projected facility needs ascribable to places of various population sizes cannot be reliably estimated at this time. In view of the increasing preponderance of large institutions ir education, it can be assumed that the bulk of the required construction will occur in communities of substantial size.

(c) *Types of Institutions Responsible for Projected Outlay*

The proportions of prospective capital outlay to be expended by public and private institutions are estimated as follows: Public, percent; private, 41 percent.

In the public sector, the proportion of funds to be expended other than State governments and State agencies cannot be reliably estimated. In the private sector, the overwhelming majority of institutions are nonprofit.

[5] In fact, it appears likely that the effect of enrollment increases, beyond the levels currently pr be partially offset by gains in the efficiency of the educational process, and by increases in the av of the "academic year," resulting from the current trend toward the adoption of quarter ar calendars in higher education.