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UTILITIES

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Utilities take their name from the usefulness of the services they provide. These include tap water, sanitation, electricity, gas, telephone, and transportation. Today, utilities are virtually synonymous with public utilities. As the latter name suggests, utilities are often owned by government, and when they are in private hands, they are most often regulated by government.

In the United States, the appearance of utilities was spurred by the development of urban places. In rural areas, individuals typically supply their own water, sanitation, energy, and transportation. In cities, such individual procurement is ineffective and counterproductive. One person's water supply is another's latrine;

one person's yard is another's garbage dump. Foraging chickens, pigs, and goats mean animal waste and dead animal carcasses on streets and in vacant lots.

Individuals are poorly situated to address such problems on their own. One reason has to do with the "public good" aspect of such situations. Clean water at my local watering hole benefits not only me, but also my neighbors. The incentive for me to clean up is less than the value of such cleanup to the community as a whole. In an environment where individuals are responsible for their own cleanup, such services are underprovided and individuals are better off if water is supplied by an agency that responds to the needs of the community as a whole.

Another reason why utilities are difficult to procure individually has to do with the nature of the technology. Water provision, waste disposal, and electricity, gas, telephone, and transportation services involve extensive networks of pipes and wires, and of distribution, collection, and disposal routes. Utilities are extremely expensive if they are not networked in this fashion.

Networking reduces the average cost to consumers, but it also means economic power for the provider since more than one network would be redundant. In economic terms, this characteristic makes utilities "natural monopolies" because a single company can offer services at lower cost than two competitors. Market pressures push for the elimination of all but one provider. Once a single firm is the sole provider in a market, however, that firm has an incentive to charge customers high rates. Since the service is necessary and there is no competition, consumers have little choice except to pay.

Because of their tendency toward natural monopoly, utilities are often owned by governments; when held privately, they are heavily regulated. An important objective of government ownership and regulation is to set prices close to costs, including as a part of costs a "fair" or normal return on the capital invested. Governments also oblige utilities to provide services to all citizens, even those for whom service might come at high cost. An example of a high-cost utility provision is the rural electrification program begun in 1935 that built more than one third of a mile of electrical line for each customer serviced, considerably more line per customer than in densely packed urban areas (see series Dh277–278). By the 1950s, more than 95 percent of rural residents had access to electricity (series Db239). Privately owned utilities do not appear to have taken the mandate to provide services to all citizens as seriously as those that are owned by the government. For example, Troesken (2001) shows that public water companies provided black communities with better service than did private water companies.

The ownership and regulation of utilities are often matters of intense public debate. Conditions that seem to justify regulation during one phase of history may change because of new technologies and new industries offering substitutes. The development of government ownership and regulation of utilities is the subject of a large body of literature.¹

An important characteristic of utilities is their "networked" character. Utilities themselves are networks, that is, complex, large-scale systems that cross and interconnect in ways that require coordination and management. In addition, utilities form part of

¹ See, for example, Demsetz (1968), North (1990), Troesken (1996, 1997), and Williamson (1985). For an analysis of the recent *deregulation* of utilities, see Hirsh (1999).

even larger networked systems that include housing, industry, technology, civic organization, and labor. The interconnectedness of utilities with other institutions, combined with their physical durability, gives *history* a role in the impact of utilities on any particular region's economic and social development. The contrasting suburban developments surrounding Boston versus Los Angeles are one example. Boston's high-density suburbs reflect the impact of the trolleys that dominated intraurban transit at the time of their growth in the late nineteenth century; Los Angeles's post-World War I growth with its suburban sprawl reflects the impact of the automobile.

Another example, developed by Norris Hundley Jr., concerns the consequences of water rights laws in affecting the differential growth of Los Angeles and San Francisco. It is surprising today that these two cities' size and structure are so different. In many ways, their growth and development followed similar routes. Initially, both cities relied on local water resources. As they grew, their semi-arid environments meant that they had to develop more distant water-supply sources. San Francisco ultimately found water by damming the Toulumne River in the Hetch Hetchy Valley, 170 miles to the east of the city, and Los Angeles did so by diverting the Owens River, 235 miles to the north and on the eastern side of the Sierras. At the same time, certain differences in the legal environments in which the two cities operated produced important differences in their size and organization. By the time San Francisco city officials appreciated the need for distant water resources, a private company, Spring Valley Water Works, had already gained control over the local water supply. Much of the drama of that city's growth during the late nineteenth and early twentieth centuries involved the process of establishing public control over this private company. By contrast, Los Angeles, which developed later, possessed control of its local water resources from the beginning. Growth of the city took place in a legal environment that permitted the sale of local water to city residents only. The superiority of the Los Angeles River flow in Southern California combined with the legal restriction on the sale to city residents prompted a large number of neighboring communities to apply for absorption into the rapidly sprawling metropolis. Today, when much of Los Angeles's water comes from distant sources not covered by the initial agreement, the city still governs a large geographic area.²

The essay in Chapter Db discusses the development of electricity and its impact on the layout of manufacturing plants, machine design, and the organization of work. Similar stories could be told about the impact of municipal water provision.³ Information on utilities may be found in several chapters of *Historical Statistics of the United States*. Electricity and gas are discussed in Chapter Db; railroads, public transportation, and roads, in Chapter Df; and the telephone and telegraph, in Chapter Dg. The purpose of this essay is to bring together these disparate elements, to discuss data on utilities as a whole, and to comment on those utilities not treated elsewhere.

² For a comparative history of San Francisco and Los Angeles water procurement, see Hundley (1992), Chapter 4, pp. 121–202.

³ For overviews, see Baker (1899), Armstrong (1976), Tarr (1996), Jacobson (2000), and Melosi (2000). For region- and city-specific histories, see Cain (1978) on Chicago; Hundley (1992) on California; Taylor (1926) on San Francisco; Ostrom (1953), Kahrl (1982, 1993), and Mulholland (2000) on Los Angeles; and Weidner (1974) on New York.

Waterworks

Waterworks emerged as the first utility, their growth and development following that of urban places. It is easy to understand why this was the case. The rural practice of procuring water directly from local wells and streams worked poorly in cities. In sparsely populated rural environments, natural groundwater collectors would carry over water from wet years into dry so as to permit a continuous flow. In densely populated urban regions, growing populations quickly drained groundwater reserves from wet years, creating crises during dry seasons. In an effort to combat the problem, cities developed public waterworks that dammed rivers, tapped distant resources, and recycled nominally undrinkable water for public water supplies. As early as 1652, the basic structure of Boston's public waterworks was already in place. By 1800, sixteen American cities, or half of all urban places, boasted waterworks plants (Table Dh240–241).

As the urban population expanded in the eighteenth and early nineteenth centuries, many of these city water systems became contaminated with human, animal, and industrial waste. Water contamination and accumulations of refuse bred disease. Periodic urban epidemics killed rich and poor and young and old alike. In the late eighteenth and nineteenth centuries, massive cholera and yellow fever epidemics hit major U.S. cities. In 1793, more than 5,000 died in a yellow fever epidemic in Philadelphia. In 1832, cholera took the lives of more than 3,000 people in New York and more than 4,000 in New Orleans. In 1853 and again in 1867, yellow fever killed more than 7,000 and 3,000 persons, respectively, in New Orleans (Rosenberg 1962). As medical theories of disease contagion gained acceptance over the nineteenth century, people came to appreciate the environment as a source of disease, and city governments began to take on responsibility for water purity. The resulting surge in city waterworks is shown in Table Dh236–239.

Early waterworks were most often financed and controlled by private investors. In 1800 among the sixteen waterworks nationwide, all but one was privately owned (Baker 1899, pp. 13–14). Over the course of the nineteenth century, the number of waterworks increased, and, at the same time, their ownership shifted from private to public hands (series Dh239). This transfer of waterworks from private to public ownership was evident in all communities, but it was especially pronounced in the larger cities. Larger cities developed mechanisms for raising money, especially the right to tax their citizens and to issue bonds. Private utility ownership resulted in high prices and management improprieties (Baker 1899, pp. 31–50). As a consequence, over the course of the nineteenth century, older cities with privately held waterworks purchased them on behalf of the public. New cities were increasingly likely to begin their operation with public services. Case studies of the transfer of waterworks from private to public ownership make for lively reading (see, for example, Hundley 1992).

Data on public expenditures on waterworks are available beginning in 1900 and are displayed in Figure Dh-F. They indicate substantial growth of real per capita governmental expenditures over the twentieth century. One reason for the growth is that an increasing share of the population was served by these public utilities. Another is that individuals and firms – both industrial and agricultural – used more water once it was conveniently supplied by tap. For data on per capita water usage over time, see Table Cf156–167. Third, the shift of population out of the moist East and to the arid West meant higher costs for water delivery.

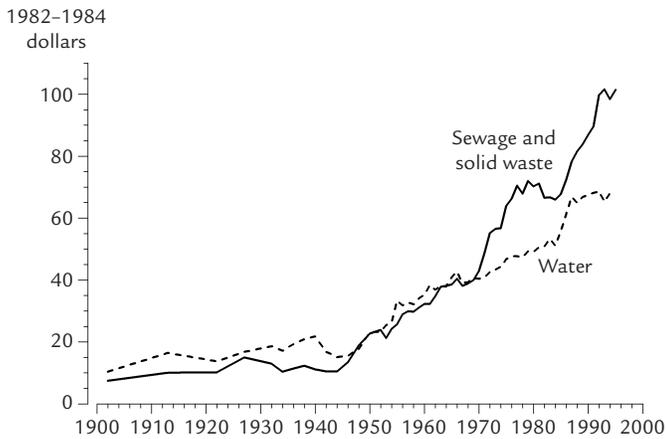


FIGURE Dh-F Per capita government expenditures on water and sanitation: 1902–1995

Sources

Series Ea100 and Ea114, converted to per capita terms using series Aa7, and then to constant dollar terms using series Cc1.

Dams, Reservoirs, and Aqueducts

In 1790, American cities relied almost exclusively on local sources for their water supply. Rapid city growth during the first part of the nineteenth century forced cities to look beyond their boundaries to expand their total supply and to ensure additional supplies during dry years. Cities began building dams, creating reservoirs, building aqueducts, and laying pipes to collect and store distant water and to make it available to their denizens. Many of the early projects appear to have been initiated after a public emergency such as an epidemic or a fire. Statistical information on the timing and cost of these water-storage and delivery projects are available in the municipal records of individual cities. As far as I am aware, no one has aggregated this information on dams and aqueducts into an overview for the nation as a whole.

Prominent early projects include Boston's aqueduct from nearby Jamaica Pond, completed in 1796; Philadelphia's 1801 use of steam engines to shift the city's water supply from the contaminated Delaware River to the sanitary Schuylkill River; New York's forty-mile-long Croton Aqueduct, completed in 1842; and Boston's twenty-mile-long Cochituate Aqueduct, completed in 1848 (Blake 1956). Chicago gained worldwide attention in 1871 when it first attempted to reverse the flow of the Chicago River as a way of keeping contaminants out of Lake Michigan. The project finally succeeded in 1900 (Cain 1978).

Settlement of the arid West led to even more ambitious water projects. The small quantity and the strong seasonality of rain in the West required large storage reservoirs capable of capturing winter rains and spring floods for release in the late summer and early fall. More than 600 such projects were launched after the establishment in 1902 of the U.S. Bureau of Reclamation, whose mandate was to "reclaim" Western lands through irrigated agriculture and the provision of family homesteads. Operating in seventeen Western states, the Bureau of Reclamation quickly became a world leader in dam engineering and construction. Its two most famous projects are the Hoover Dam on the Colorado River, completed in 1936, and the Grand Coulee Dam on the Columbia River, completed in 1942. A hundred years after its founding, the Bureau of Reclamation is the

nation's largest water wholesaler and its second-largest producer of hydroelectric energy.⁴

Some cities received their drinking water from the Bureau of Reclamation's water system, but others, most notably San Francisco and Los Angeles, built their own. The merits of these projects remain controversial to this day.⁵

The Tennessee Valley Authority (TVA) and the Bonneville Power Administration are two major water projects that were constructed and run independently of the Bureau of Reclamation. These extensive public projects were built primarily to generate hydroelectric power and for flood control rather than for water supply. Both were part of the New Deal legislation of the 1930s. The TVA was launched in 1933 over the entire Tennessee River basin. It came to encompass thirty-one separate dams (see Table Dh268–273). The Bonneville system on the Columbia River between Washington and Oregon was built between 1933 and 1943. Both systems are major sources of hydroelectric power generation.

Sewers

Today sewers and water mains are coordinated systems, but in the nineteenth century most cities – including those with highly developed water systems – relied on privy vaults and cesspools for sewage disposal. The differential in expenditures for the two systems is shown in Table Dh287–292. Sewers were late to develop because at least initially privy vaults and cesspools were acceptable methods of liquid waste disposal, and they were considerably less expensive to build and operate than sewers.

Sewers began to replace privy vaults and cesspools as running water became more common and its use grew. The convenience and low price of running water led to a great increase in per capita usage. The consequent increase in the volume of waste water overwhelmed and undermined the efficacy of cesspools and privy vaults. According to Martin Melosi, "the great volume of water used in homes, businesses, and industrial plants flooded cesspools and privy vaults, inundated yards and lots, and posed not just a nuisance but a major health hazard" (Melosi 2000, p. 91).

Joel Tarr also notes the impact of the increasing popularity of water closets over the later part of the nineteenth century (Tarr 1996, p. 183). Water closets further increased the consumption of water, thus contributing to the discharge of contaminated fluids.

Once the decision to build sewers and integrate them with the water mains was made, cities had to grapple with enormous technical, management, finance, and political issues before the systems were successful. Joanne Abel Goldman's detailed study of the building of New York City's sewers illustrates the nature of these problems (Goldman 1997). Tables Dc364–389 and Dc476–493 provide information on water and sewer line construction. Governmental expenditures on sewage are shown in Table Ea61–124.

⁴ U.S. Bureau of Reclamation Internet site; Pfaff (2000); and Robinson (1979); also see Table Dh268–273.

⁵ See, for example, Hundley (1992), Taylor (1926), Ostrom (1953), Kahl (1982, 1993), and Mulholland (2000). For a listing of California's major dams and reservoirs, see the Division of Safety of Dams Statistical File, available from the Internet site of the California Department of Water Resources.

Solid Waste

Solid waste disposal is a relatively recent problem. In earlier times, people did not own many objects, and those they did own were pressed into service in a variety of ways. Thus a broken bottle, excavated from a colonial-era Virginia plantation, was found to have been transformed into a “bowl” and a “funnel” (Strasser 1999, p. 21). Objects discarded by one family were often collected by others. “Swill children” went from house to house in nineteenth-century cities collecting kitchen refuse to sell for fertilizer and hog feed. Well into the twentieth century itinerant rag-pickers and paper-collectors went from house to house offering money or housewares in exchange for discards. Susan Strasser provides a detailed account of the transformation of an early culture that valued the “stewardship of objects” into our modern world in which the plethora of discards has made trash disposal a serious social problem (Strasser 1999).

The first solid waste disposal problem to attract the attention of policymakers was a consequence of an increase in the use of urban horses over the nineteenth century. Manure was one problem.

Sanitary experts in the early part of the twentieth century agreed that the normal city horse produced between fifteen and thirty pounds of manure a day, with the average being about twenty-two pounds. In a city like Milwaukee in 1907, for instance, with a human population of 350,000 and a horse population of 12,500, this meant 133 tons of manure a day, or an average of nearly three-quarters of a pound of manure per person per day. Or, as the health officials in Rochester calculated in 1900, the 15,000 horses in that city produced enough manure in a year to make a pile covering an acre of ground 175 feet high and breeding sixteen billion flies. (Tarr 1996, pp. 323–4)

The carcasses of dead horses were another.

A description of Broadway appearing in the *Atlantic Monthly* in 1866 spoke of the street as being clogged with “dead horses and vehicular entanglements.” In 1880 New York City removed 15,000 dead horses from its streets; and as late as 1912, Chicago carted away nearly 10,000 horse carcasses. (A contemporary book on the collection of municipal refuse advised that, since the average weight of dead horses was 1,300 pounds, “trucks of the removal of dead horses should be hung low, to avoid an excessive lift.”) (Tarr 1996, p. 327)

Ironically, social critics of the time looked to the development of the “horseless carriage,” or the automobile, as a solution to cities’ sanitary problems.

By this time, scientists had already made the connection between cleanliness and health, publicly managed water and sewer systems were the norm, and Progressive social reform movements had identified cleanliness with civic pride and good government. Thus, recognition of the trash problem rather quickly led to the appearance of public solid waste disposal systems (see Melosi 2000, Chapters 13, 20).

The rise of per capita real income and the development of a “consumer society” over the twentieth century intensified the garbage problem. Rags, paper, and other such items that commanded a market in the nineteenth century were transformed into garbage during the twentieth. An increasing fraction of purchases, especially food products, were dispensed in packaging formats that were disposable. Strasser offers a detailed and highly readable account of the

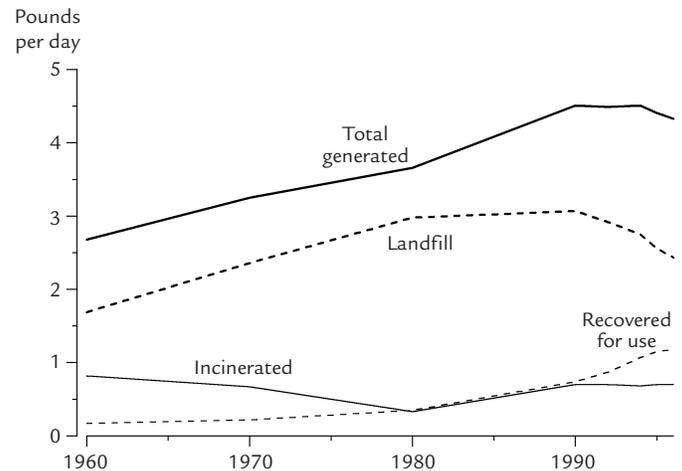


FIGURE Dh-G Solid waste generation and disposal per capita: 1960–1996

Sources

Series Dh293–294 and Dh296–297.

process as a whole and of individual products that were emblematic of the transformation (Strasser 1999). Statistics on per capita solid waste generation indicate that the average American was generating 2.68 pounds of solid waste per day in 1960, and that this statistic rose by two thirds over the next thirty years.

Alarmed by these developments, counterculture groups began to practice waste restriction and recycling in the 1960s. Over time these efforts gained supporters and led to an overall reduction in solid waste production per capita and to a rapidly rising share of solid waste that is composted and recycled. Beginning in 1960, the U.S. Environmental Protection Agency reported statistics on solid waste disposal by type. These statistics are provided in Tables Cf211–216 and Dh293–297 and are shown in Figure Dh-G.

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