

THE ECONOMICS OF SUBSIDIES TO RURAL NETWORKS: IMPLICATIONS FOR BROADBAND IN THE UNITED STATES¹

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ABSTRACT

Economies of density is a critical supply-side characteristic of network industries. At customer density levels that are low enough, any network will reach a point at which provision of service is unprofitable without a subsidy. We examine the scope of these areas in the United States. We compare and contrast the extent of subsidies (or lack thereof) in the major network infrastructure industries: telecommunications; electric power distribution; natural gas distribution; water and sewer networks; roads; and airlines. We also consider the importance of ownership type in the history of regulation and subsidies in network industries. We focus on the implications of the Federal Communications Commission's current plans for broadband subsidies in rural areas.

I. INTRODUCTION

The Trump Administration reduced or contemplated the reduction of federal spending on some programs, particularly on activities that could be characterized as “subsidies.” These include a Medicare and Medicaid services notice that “would cut marketplace subsidies by \$980 million in 2020 and by \$4.26 billion over four years”;⁴ a proposed 15% reduction in “overly generous” farm subsidies in 2020;⁵ a threat to withhold subsidies to General Motors;⁶ cutting Amtrak funding in half in the 2018 budget;⁷ and

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⁴ Edwin Park, *More Sabotage: Trump Administration Cuts Marketplace Premium Subsidies*, GEO. U. HEALTH POL'Y INST.: SAY AHHH! (Apr. 26, 2019), <https://ccf.georgetown.edu/2019/04/26/more-sabotage-trump-administration-cuts-marketplace-premium-subsidies>.

⁵ Humeyra Pamuk, *Trump Budget Proposes Steep Subsidy Cuts to Farmers as they Grapple with Crisis*, THOMSON REUTERS (Mar. 11, 2019, 10:54 AM), <https://www.reuters.com/article/us-usa-trump-budget-usda/trump-budget-proposes-subsidy-cuts-to-farmers-as-they-grapple-with-crisis-idUSKBN1QS28Z>.

⁶ See Scott Horsley, *Trump Administration Threatens to Withhold Subsidies from GM*, NPR (Nov. 27, 2018, 4:33 PM), <https://www.npr.org/2018/11/27/671231681/trump-administration-threatens-to-withhold-subsidies-from-gm>.

⁷ Kirsten Korosec, *Amtrak Funding Slashed in Half Under Trump Spending Plan*, FORTUNE (Feb. 12, 2018, 4:48 PM), <https://fortune.com/2018/02/12/amtrak-funding-cut-trump-spending-plan>.

“more reduction in spending than any president in history has ever proposed” via further reductions in clean energy spending.⁸

In light of these recent reductions in federal subsidies, we examine network industries in rural areas and their possible continued need for subsidies. Network industries are generally considered to represent important infrastructure and the economics of these industries are different from other industries in some respects. This Article examines communications, roads, airlines, water and sewer, and electric power distribution as some of the key network infrastructure industries and the degree to which they have been deployed in rural parts of the United States. The form of ownership is considered with respect to the likelihood each industry is, or was, regulated.

These network industries are compared in respect to the need for subsidies in low-density rural areas and the methods by which such subsidies are provided or not. For convenience we will use the term “low-density” to refer to “low-population density” or “low-user density” (for example, in the context of roads or mobile telecommunications networks).

Networks in general exhibit economies of density; that is, costs per user (or usage unit) are lower in high-density areas. This creates natural monopoly-like cost characteristics in networks, especially in less dense areas. Additionally, these economies of density contributed toward the regulation of some networks in the mid-twentieth century, with diminished regulation in the later portion of the twentieth century.⁹ As one moves to more rural areas, with any network (with or without regulation) serving the population in a geographic area, the costs per user become increasingly high, eventually leading to unsustainable business models.

In this respect, there are similarities between networks serving geographic areas in communications, electric power, roads, railroads,¹⁰ airlines, natural gas distribution, water distribution, and sewer networks. By the very nature of network economics, each industry exhibits economies of density and each reaches a point at which unsubsidized service in low-density areas is not viable. Some of the causes of higher costs in low-density areas are discussed in this Article using communication network examples as an illustration. In addition, the scope of low-density areas in the United States is illustrated.

The importance of subsidies to networks in low-density areas is described for each of the major United States network industries. An important distinguishing factor is whether there are substitute methods of providing similar services (for example, wells for water, propane tanks instead of natural gas networks, septic systems instead of sewer networks). While our analysis focuses on the network industries in the United States,

⁸ Marianne Lavelle, *Trump Budget Calls for Slashing Clean Energy Spending, Again*, INSIDE CLIMATE NEWS (Mar. 12, 2019), <https://insideclimatenews.org/news/12032019/trump-budget-cuts-renewable-energy-efficiency-electric-vehicle-tax-credit-deficit>.

⁹ See generally SAM PELTZMAN & CLIFFORD WINSTON, *DEREGULATION OF NETWORK INDUSTRIES: WHAT'S NEXT?* (2000) (discussing regulatory reform in airlines, railroads, telecommunications, and electric power in the United States).

¹⁰ We spend little time in this manuscript discussing railroads since there is virtually no issue of railroads providing service in the most rural areas of the United States. In part, this is due to the ready substitutes to rail services offered by airlines, automobiles and public transit for passenger traffic and by trucks for non-passenger transport.

we believe similar issues and circumstances exist in many other industrialized countries.

We compare and contrast network industries and offer guidance for subsidies of broadband services to rural areas in the United States. This is germane due to the Federal Communications Commission's ("FCC") continuing efforts to push broadband investment into increasingly rural areas. For example, in 2018 the FCC held the Connect American Fund II ("CAF II") auction that awarded over \$1.4 billion in federal subsidies for broadband deployment in extremely high-cost-to-serve areas of the United States.¹¹ In addition, the FCC is planning an upcoming reverse auction for \$4.5 billion in federal subsidies to build out wireless infrastructure in areas currently unserved by 4G Long Term Evolution ("LTE") wireless service.¹² Finally, and most recently, in April of 2019, the FCC announced the Rural Digital Opportunity Fund, which will provide up to \$20 billion in funding to extend broadband service in rural America.¹³

We also consider the issue of economies of scope and the potential for competition-distorting behavior when a firm effectively has a franchise monopoly in one market (for example, via rate-of-return regulation) but also offers services in a potentially competitive market (such as bidding for subsidies for broadband in a reverse auction).

II. THE ECONOMICS OF RATIONAL CAPITAL INVESTMENTS

Any private entity contemplating a capital investment project must begin by comparing the benefits of the investment to the costs of that investment. For a government entity, the benefits from an investment might not translate into greater revenue from government-offered services or greater tax revenue. However, the better measure of such an investment is whether the benefits to the citizens outweigh the costs, potentially subject to some constraints imposed by the budget of the governmental agency.

In contrast, for a business to remain viable, the benefits from an investment must (eventually) be measured as the change in revenues that result from the investment. The change in revenues could accrue by adding customers, increasing the volume of usage of existing services (if volume-sensitive prices exist), adding services to an existing customer base, or by changing the quality, functions, and features of services that yield greater value to customers (generally at higher prices, or with lower customer turnover).

More specifically, any investment must produce a stream of benefits that is greater in present value than the stream of costs.¹⁴ Since business benefits

¹¹ See Wireline Competition, *Connect America Fund Phase II: Auction 903 Results*, FED. COMMS. COMM'N (Apr. 3, 2019), <https://www.fcc.gov/reports-research/maps/caf-ii-auction-results-april-2019>.

¹² See Office of Economics and Analytics, *Mobility Fund Phase II (MF-II)*, FED. COMMS. COMM'N (May 18, 2020), <https://www.fcc.gov/mobility-fund-phase-ii-mf-ii>.

¹³ Joan Engebretson, *Pai Proposes FCC Rural Digital Opportunity Fund: \$20.4 Billion Over 10 Years for Price Cap Territories*, TELECOMPETITOR (Apr. 12, 2019), <https://www.telecompetitor.com/pai-proposes-fcc-rural-digital-opportunity-fund-20-4-billion-over-10-years-for-price-cap-territories>.

¹⁴ This principle is even applied to government decisions, at least in theory. See, e.g., OFF. OF MGMT. & BUDGET, CIRCULAR A-94: GUIDELINES AND DISCOUNT RATES FOR BENEFIT-COST ANALYSIS OF FEDERAL PROGRAMS 4 (Nov. 2015), <https://www.wbdg.org/FFC/FED/OMB/OMB-Circular-A94.pdf>

must eventually be translated into revenues, the net present value (“NPV,” or the revenues net of costs in present value) of any investment must be positive.

Many firms, facing limitations on capital acquisition or a limited capital budget, must choose between multiple possible positive NPV investments. Economically rational firms¹⁵ will tend to choose those investments with the highest internal rate of return (“IRR”) (among investment choices that are not mutually exclusive) until either the IRR falls below the weighted average cost of capital (“WACC,” which is discussed in a section below) or until capital funds are exhausted.¹⁶ In some instances, these two primary investment criteria (NPV and IRR) are supplemented with other criteria, such as breakeven time periods and other investment ratios.¹⁷

However, in addition to considering IRR, firms will also overlay an analysis of the risks of each investment vis-à-vis the risk of their existing portfolio of investment projects and, more importantly, the risk of other possible projects that could be chosen (in lieu of the project being evaluated).

The managers of for-profit public corporations have fiduciary responsibilities to engage in such rational investment analysis. Models of profit-maximizing behavior and investment analysis also provide a reasonable first approximation for assessing the behavior of not-for-profit firms. These firms must avoid taking losses and rational project evaluation is an important part of avoiding losses. Indeed, cooperatives and other non-profit ventures must consider the sustainability of investments and IRR, even if their goal may be to reach a breakeven state in lieu of necessarily realizing profits.

III. COSTS IN ECONOMICS

The fundamental cost concept in economics is that of opportunity cost: that is, costs are determined by the value of resources in their next best alternative use.¹⁸ To evaluate cost, one should first identify the resources that are used in providing a service, and then value those resources. The value of

(stating that “[t]he standard criterion for deciding whether a government program can be justified on economic principles is net present value.”).

¹⁵ Firms may face regulation or legal constraints that coerce investments that are not NPV positive *per se*.

¹⁶ For investment opportunities that are mutually exclusive (in the case of two different ways in which to solve a single customer problem in a custom bid environment), as a first approximation, the firm should rely upon NPV if (and only if) both mutually exclusive choices have an IRR above the threshold value. Technically, if an option requires a large share of the firms’ capital budget, one should evaluate the IRR of other investments that are crowded out (if any) by the higher NPV choice.

¹⁷ We prefer to consider only IRR and NPV, but these are not the only metrics utilized by others. See, e.g., BRUCE ALLEN ET AL., *MANAGERIAL ECONOMICS: THEORY APPLICATION AND CASES* (W.W. Norton & Co. ed., 8th ed. 2013); RAY H. GARRISON, *MANAGERIAL ACCOUNTING: CONCEPTS FOR PLANNING, CONTROL, DECISION-MAKING* (Bus. Publ’ns Inc. ed., 5th ed. 1988).

¹⁸ See virtually any text on the principle of economics, microeconomics, or managerial economics. See, e.g., PAUL HEYNE, *Opportunity Cost and the Supply of Goods*, in *THE ECONOMIC WAY OF THINKING* (Sci. Rsch. Assocs. ed., 5th ed. 1987). For a focus on costs associated with business decisions, see JAMES BUCHANAN, *COST AND CHOICE: AN INQUIRY IN ECONOMIC THEORY* (1969); JAMES M. BUCHANAN & GEORGE F. THIRLBY, *L.S.E. ESSAYS ON COST* (1981).

those resources in their best alternative use is generally reflected via the market price of the resources.¹⁹

One can consider the costs of any potential project or business decision as falling into three categories: (1) maintenance and customer-related operations costs; (2) capital costs; and (3) shared, common, or joint costs.²⁰ Consider the last category first. Costs truly shared across all projects, or “common and joint” costs, are caused by the operations of the provider in total. These common costs are often labeled “overhead” costs by accountants. Moreover, common and joint costs are not directly caused by the contemplated project—they are caused by the existence of the firm and its operations in total. However, we know that firms must recover these costs or else eventually become insolvent. Moreover, some of the costs that are labelled overhead are likely to be, at least partially, impacted by new projects (although the path of this potential cost causation is less obvious).²¹ Such costs are often included in cost calculations and rate-setting in telecommunications, as well as other regulated or previously regulated industries.²² Any firm must recover these costs in some way.

Maintenance and customer-related operations costs are generally easier to contemplate. These costs are dominated by short-lived material costs (those items that are not treated as a capital expenditure) and labor costs. For broadband services, these maintenance and operations costs include customer acquisition and retention costs (including marketing in new geographic areas), labor and materials for maintenance of network operations, customer service, and the plant.

For those activities and assets that are clearly caused by and associated with a new project (such as providing broadband service in a new geographic area), there will be directly attributable maintenance and customer-related operations costs. Additionally, capital expenditures will likely be incurred to provide the services enabled by the new project.

Capital costs should reflect the opportunity costs of the resources required to create long-lived capital assets. The capital-related costs considered in the annual cost of a project are: (1) depreciation, (2) the return on capital, and (3) associated taxes. Economic depreciation should reflect the change in value of the asset over time. In a simple case, a new asset is purchased for a project and used exclusively for that project. If the asset is later sold or scrapped, depreciation reflects the difference between the purchase price and the later salvage or sale price. Even if the business uses an existing capital asset, there will be a change in the market value of the asset put to one use (rather than using the resources elsewhere) for some

¹⁹ As a technical matter, it is possible that the highest-valued alternate use of the resource is by the same firm, and, therefore, the market value would represent a lower bound on the opportunity cost of the resource.

²⁰ Accountants tend to include these costs in categories such as general and administrative costs (“G&A”).

²¹ For example, a new project leads to the hiring of 100 new employees. While the salary, wage and benefits costs of those new employees would show up in the business case analysis, the cost of HR-related services and employee training (indirectly caused by the existence of the new employees) may not show up in the business case analysis.

²² See HANK INTVEN ET AL., TELECOMMUNICATIONS REGULATION HANDBOOK MODULE (2000), <http://www.infodev.org/en/Publication.22.html> (stating that “by including capital, joint and common costs, a LRIC approach can approximate costs in a competitive market”).

period. The loss of value of an asset can be due to simple wear and tear or obsolescence. That is, part of the change of value of the asset is likely due to technical progress—the price of a replacement asset may decrease, which decreases the value of the existing asset or the asset may be replaced by newer technologies. This change in age, price, and technology is part of economic depreciation. In short, assets decline in value by way of depreciation, incurring real economic costs.

In addition to depreciation, there is the opportunity cost of having monies tied up in capital assets.²³ This reflects the lost opportunity to have earned a return from another investment. Like depreciation, this is a valid and very real opportunity cost, which is also referred to, and calculated as, WACC.²⁴ For-profit organizations can obtain funding from two categories: debt and equity. WACC reflects the costs of each type of funding weighted by the proportion of funding that is derived from debt and equity.²⁵

The cost of debt is relatively straight-forward: it is the interest rate(s) for the relevant loanable funds.²⁶ The cost of equity is determined by expectations of equity investors contemplating purchasing stock of comparable-risk companies. Since the 1960s, it is generally estimated using the capital asset pricing model (“CAPM”).²⁷ No business, or potential business, will make an investment without an expectation that the revenues generated from the investment will be sufficient to provide a return on that investment (for example, the recovery of depreciation expenses over time), and a return on the monies invested (for example, WACC).

In many network industries including communications, these aforementioned capital costs are particularly important because such industries are relatively capital-intensive. These principles are generally accepted worldwide. For example, the World Bank specifically states:

“Because the telecommunications industry is capital-intensive, the cost of capital is a critical issue in determining telecommunications costs, regardless of the costing methodology used. The main point to recall is that the regulator has to incorporate the correct measure of the cost of capital in its costing methodology in order for the regulated operator to recover all of its efficient capital costs, including its equity and debt costs.”²⁸

²³ The opportunity cost is determined by the time value of money, as determined in the markets for debt and equity capital.

²⁴ See, e.g., *Weighted Average Cost of Capital*, WIKIPEDIA (Jan. 22, 2021, 7:55 AM), http://en.wikipedia.org/wiki/Weighted_average_cost_of_capital. It is noteworthy that the Wikipedia listing for WACC has “opportunity cost” under the “See also” category.

²⁵ The firm may have multiple types of debt and multiple types of equity (for example, preferred and common stock). The WACC calculation would reflect the cost of each type of equity as well as the proportion of each type of equity.

²⁶ A company may finance via several types of debt instruments. One can calculate a weighted average cost of debt across those sources.

²⁷ See, e.g., William F. Sharpe, *Capital Asset Prices With and Without Negative Holdings: Nobel Lecture, December 7, 1990*, in *ECONOMIC SCIENCES 1990*, 312, 312, <https://www.nobelprize.org/uploads/2018/06/sharpe-lecture.pdf>.

²⁸ INTVEN ET AL., *supra* note 22, app. B, at 11.

In *Figure 1*, the breakout of the network operation, customer operations, G&A, and capital costs discussed above are shown for the average fiber-to-the-home deployment across the United States. As is evident in this chart (sourced from the FCC), fiber deployment for broadband service is very capital-intensive, as “Capital Recovery (Depreciation),” “Cost of Money,” and “Tax” represent 45% of the expected monthly costs. In rural areas, this capital burden jumps to over 54% of expected monthly costs.

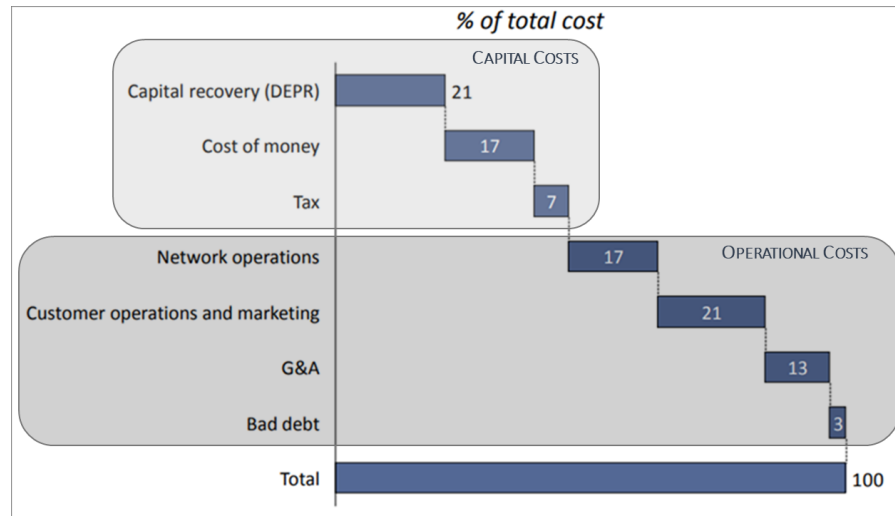


Figure 1: Illustrative breakdown of typical costs for Broadband Service (Source: FCC, CQA)²⁹

IV. COSTS OF NETWORKS AND ECONOMIES OF DENSITY

Networks are common in modern economies. Examples of networks include roads, railroads, telecommunications, internet,³⁰ airlines, natural gas distribution, electric power distribution, water distribution, and sewage networks. Each network exists as an interconnection of geographically-located nodes (for example, a switch or a customer location) and links connecting those nodes (via a fiber cable or a pipe). A variety of functions may be performed at nodes, including: terminal (customer locations); branching (cables, pipes or roads); consolidation (cables or pipes); conversion (optical to electronic in telecommunications, protocol conversion in internet or IP-based telephony, voltage transformers in electric power); storage (water and natural gas); or switching (telecommunications and railroads). Networks are also generally considered an important part of national infrastructure. These networks are often considered essential and the provision of network services to the great majority of the population is a goal in many countries.

²⁹ FED. COMMS. COMM’N, CONNECT AMERICA COST MODEL OVERVIEW (2013), <https://docs.fcc.gov/public/attachments/DOC-323344A1.pdf>.

³⁰ We do not discuss the internet in detail since the modern provision of internet services occurs over communications networks, particularly broadband communications networks, which we discuss in detail.

Some networks have unique economic characteristics on both the demand side and the cost/supply side. While demand-side characteristics make some networks unique (for example, communications networks),³¹ we will focus here on the supply-side conditions. One of the important supply-side characteristics of networks can be identified as economies of density. The cost per location served falls as density rises; this is a geographic analog to economies of scale.³² Or, one can state this concept in reverse: the cost per location served is higher in low-density areas.

More specifically, land-based networks exhibit economies of linear density. Costs per customer served is lower, the larger the number of customer locations per link distance (the route miles of network). This phenomenon arises in large part due to fixed (or partially fixed) costs per link distance (for example, the cost of trenching for a cable, which is relatively invariant to the capacity of the cable). It can also arise due to fixed (or partially fixed) costs for nodes (for example, minimum costs of placing and maintaining a wireless tower regardless of the volume of use).

Land-based networks often follow road networks, in part due to rights-of-way generally existing on or adjacent to roads. This means that road distances and measures of customers per road distance (for example, three customer locations per road mile), can serve as an excellent proxy for actual network link density.

In networks in general, higher utilization leads to higher costs per route distance (for example, in the form of a higher capacity cable along a pathway). However, because of economies of linear density, higher utilization along a path will generally lead to lower costs per user. The unitization per user overwhelms any potential increase in cost per route distance.³³ This is particularly important in the United States where density varies drastically. While the great majority of the United States population lives in relatively dense areas, a significant portion of the geographic area of the United States has very low linear density. This is illustrated below in *Figure 2*, which displays those areas of the country with a linear density

³¹ Regarding demand-side characteristics of two-way networks, see *Network Effect*, WIKIPEDIA (Mar. 31, 2021, 2:10 PM), http://en.wikipedia.org/wiki/Network_effect; Jeffrey Rohlfs, *A Theory of Interdependent Demand for a Communications Service*, 5 BELL J. ECON. & MGMT. SCI. 16 (1974); INGO VOGELSANG & BRIDGER MITCHELL, TELECOMMUNICATIONS COMPETITION: THE LAST TEN MILES 51 (1997); HARALD GRUBER, THE ECONOMICS OF MOBILE TELECOMMUNICATIONS 191 (2005); LESTER D. TAYLOR, TELECOMMUNICATIONS DEMAND IN THEORY AND PRACTICE 9 (Kluwer Acad. Publishers rev. ed. 1994) (stating that “[t]his is the first of two demand externalities associated with the telephone, and is usually referred to as the call (or use) externality.”); JOHN WENDERS, THE ECONOMICS OF TELECOMMUNICATIONS: THEORY AND POLICY 29 (1987) (stating “[f]inally, back to telephones. There are two possible sources of externalities here – call externalities or network externalities. Call externalities may result from the fact that both parties [of the call] may benefit from the placement of a phone call even though the cost usually falls entirely on the caller. One of the ways in which call externalities are revealed is by the value placed on telephone access [subscriberhip] to receive calls.”); see generally STANLEY LIEBOWITZ & STEPHEN MARGOLIS, *Network Effects*, in HANDBOOK OF TELECOMMUNICATIONS ECONOMICS: STRUCTURE, REGULATION, AND COMPETITION 76 (Martin E. Cave et al. eds., 2002); JEFFREY ROHLFS, *Bandwagon Effects in Telecommunications*, in HANDBOOK OF TELECOMMUNICATIONS ECONOMICS: TECHNOLOGY EVOLUTION AND THE INTERNET 81 (Sumit K. Majumdar et al. eds, 2005); JEFFREY ROHLFS, BANDWAGON EFFECTS IN HIGH TECHNOLOGY INDUSTRIES (2001); JOSEPH FARRELL ET AL., THE ECONOMICS OF INFORMATION TECHNOLOGY (2004).

³² Economies of scale is reflected in declining long-run average total costs per time period within the relevant (demand-determined) range of output. For further explanation, see virtually any intermediate microeconomics or managerial economics textbook, or see, for example, ALLEN ET AL., *supra* note 17.

³³ That is, the cost per user continues to fall even if there are some additional investments and maintenance costs that are caused by additional users.

under fifteen locations (business and residential) per road mile. These areas represent nearly 86% of the area of the lower forty-eight states, yet only 12% of the residential or business locations.

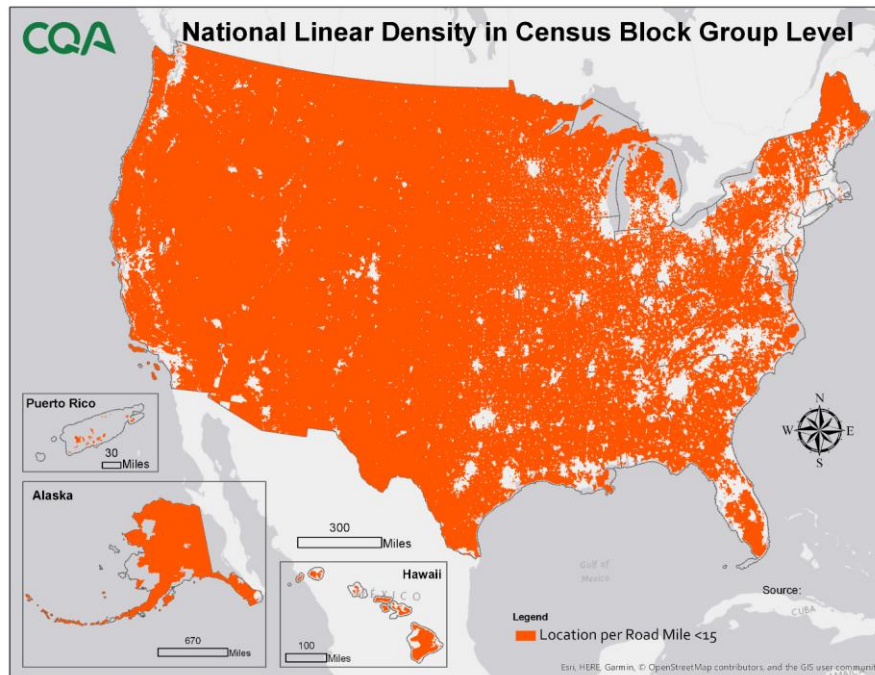


Figure 2: Census Block Groups have a linear density below fifteen locations per road mile³⁴

To illustrate the impact of linear density on network economics, the figures that follow provide a demonstration of the impact of increasing linear densities. A hypothetical ultra-low linear density area is depicted in *Figure 3*. For this area, a land-based network is deployed to provide service to the homes in the area. As shown, the distance-caused costs (fiber, material, the costs to “Engineer, Furnish and Install,” and trenching) that are fixed or insensitive to the number of housing units are triggered by the amount of road miles where the carrier must place cable along the roads to serve the customers. This road-route-driven cost is a significant portion of the measure of total cost.

³⁴ Values in each Census Block Group are derived as the total location counts in the Census Block Group divided by the total Road Miles in the Census Block Group. Location counts in a Census Block Group are sourced from CostQuest internal address location dataset, based on data consistent with data used by CostQuest to support the FCC’s Connect America Cost model. Road miles in a Census Block Group are sourced from Census’ TIGER dataset.

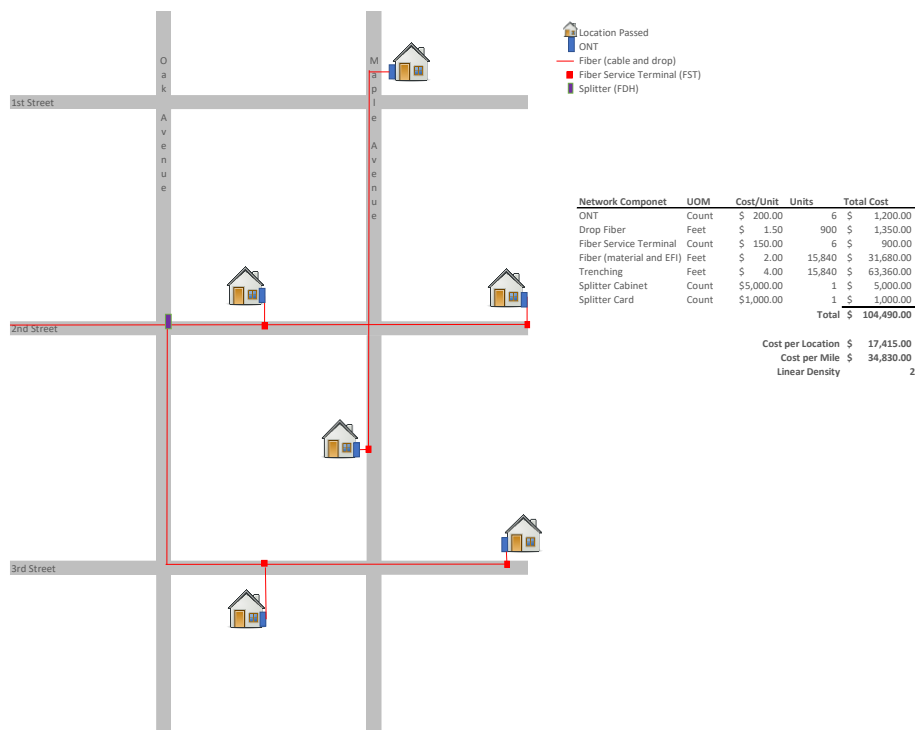
Figure 3: Ultra-Low Linear Density Illustrative Example³⁵

Figure 4 depicts a similar deployment but in an area with a linear density (population served density, in this case) four times higher than in the prior figure. While the variable cost of connecting homes increases by nearly four times, the distance-caused (for example, route mile) costs of running the cable on the roads to the homes remains relatively constant. The impact of the fourfold increase in linear density is that these distance-caused costs can now be spread over four times as many homes, thereby reducing the cost per unit from \$17,415.00 to \$4,597.50.

³⁵ The cost per unit information is based on CostQuest internal data constructed from information provided by industry clients and from values published by the FCC. These are representative costs for equipment and labor in a rural area.

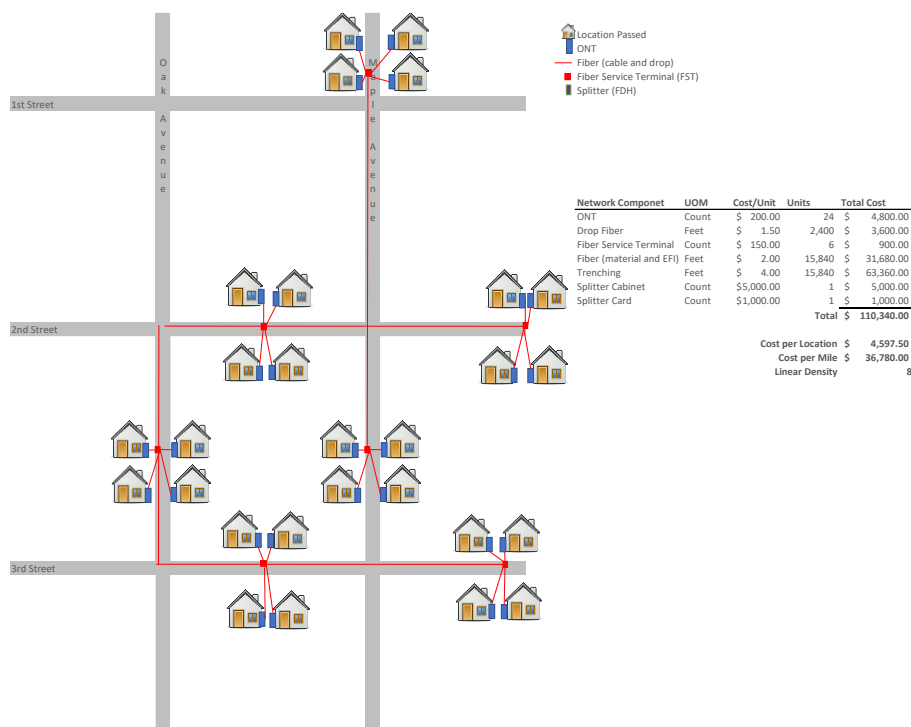


Figure 4: Low Linear Density Illustrative Example (“4xUltraLow”)³⁶

As a direct consequence of economies of linear density, for any network service potentially offered in low-density areas, three options (or some combination thereof) exist: (1) prices are higher in low-density areas to reflect higher costs, (2) service is not offered in low-density areas since demand is insufficient to cover the higher costs, or (3) the higher costs of providing service are subsidized.

In the United States and many other countries, network industries may receive subsidies or may be protected to allow internal subsidization in low-density areas to attempt to meet a government goal of ubiquitous geographic deployment. However, if there are market substitutes for the desired services provided by the network, the government is less inclined to mandate subsidies and may let the market alone determine how services are offered, if at all. In the discussion to follow, we consider some of the sources of subsidies, or lack thereof, for the more common networks: telecommunications, electric power, roads, natural gas distribution, water distribution, and sewage systems.

However, before examining subsidies to specific network industries, it will be useful to consider what constitutes a subsidy.

³⁶ This cost per unit information is also based on CostQuest internal data constructed from information provided by industry clients and from values published by the FCC. These are representative costs for equipment and labor in a rural area.

V. SUBSIDIES—A FORM OF MARKET INTERVENTION

Perhaps the most basic definition of a subsidized service is one for which the revenue generated from the service is less than the costs of the service.³⁷ More precisely, a subsidized service is one for which the present value of the revenues generated from the service is less than the present value of the costs of the service (the service has a negative NPV). We have already established that businesses in an open market will only willingly and knowingly invest in NPV positive activities, which means that they will avoid subsidization activities. In the event that the business is required by law or regulation to offer NPV negative services, some type of subsidy mechanism must be employed. Subsidies may be funded in four primary ways: (1) cross-subsidies by the same firm, (2) cross-subsidies between firms, (3) philanthropic donations, and (4) government subsidies.

The economics literature deals with cross-subsidies in detail. A cross-subsidy by the same firm involves pricing one service below cost while other services are priced above cost to a degree sufficient to cover the below-cost pricing. More precisely, the service receiving the subsidy is priced such that the present value of the revenues from that service are below the present value of the costs caused by that service—the shortfall being recovered from other services offered by that same firm. As noted earlier, any rational firm would avoid such a cross-subsidy since not offering the subsidized service (or raising the price of the service to eliminate the subsidy) would yield an overall higher stream of present-value adjusted profits. In addition, the services priced above cost to provide the cross-subsidy will invite competition, which then puts pressure on the source of funding for the cross-subsidy. Such cross-subsidies can exist, however, when prices of subsidized services are regulated or otherwise mandated by government action. This has occurred in price-regulated (“rate-of-return”) industries, as described in the sections below.³⁸ Such cross-subsidies tend to be unsustainable when the high-priced services providing the subsidies are no longer protected from competitors who force prices for the subsidy-providing services down.

A variant on this theme can occur when the firm offering the subsidized service also offers wholesale-type services to other firms at a significant markup. When the subsidizing firm is price-regulated, the cross-subsidy’s funding could be derived from high prices on wholesale-type services (for example, high switched access prices in telecommunications shortly after the divestiture of AT&T).³⁹

³⁷ The first rigorous published treatment of cross-subsidization is presented by Gerald Faulhaber, who explicitly defines subsidy-free pricing, presents two tests for cross-subsidization, and defines a possible range of subsidy-free pricing. See Gerald R. Faulhaber, *Cross-Subsidization: Pricing in Public Enterprises*, 65 AM. ECON. REV. 966, 966–77 (1975). The genesis of this literature arose due to issues in regulated industries, particularly the telecommunications industry. See Steve G. Parsons, *Cross-Subsidization in Telecommunications*, 13 J. REG. ECON. 157, 166 (1998).

³⁸ In telecommunications, for example, below-cost basic exchange service prices to residential customers were established for rate-of-return local telecommunications providers. See Parsons, *supra* note 37, at 164, and the sources cited therein.

³⁹ “Switched access charges” were established after the divestiture of AT&T as a mechanism by which to charge long-distance carriers for access to the local carriers’ networks in order to originate or terminate long-distance calls. See generally, e.g., Steve G. Parsons & James Bixby, *Universal Service in the United States: A Focus on Mobile Communications*, 62 FED. COMM. L.J. 119 (2010). Some in the industry argued that such high switched-access charges were cost-based and not actually a cross-subsidy. However, careful analysis by economists indicates this was a cross-subsidy. See Alfred E. Kahn &

Each of the first two types of subsidy forms (cross-subsidies by the same firm, and cross-subsidies between firms) rely on price regulation of at least one firm. Without rate-of-return regulation, the firm could have increased profits by raising the price of the subsidized service, or not offering the subsidized service at all. In addition, it relies on either underlying cost advantages (economies of scale or strong economies of density) by the regulated firm or regulatory protection of the subsidy-providing services. Otherwise, competitive entry into the subsidy-providing services makes the subsidy unsustainable.

As a technical matter, it is also possible to fund a subsidy through philanthropic donations. One of the authors of this Article, for example, made monthly donations for approximately fifteen years to Ameren Illinois' "Energy Assistance Foundation."⁴⁰ As a practical matter, however, such donations would likely be insignificant in supporting low-density networks.

Government funding is the fourth category of subsidy funding and is currently the most significant form found in United States network industries. As network industries in the United States became less regulated in the later part of the twentieth century,⁴¹ government funding became more important, largely because cross-subsidies are inconsistent with competitive markets and competitive investment principles.

We have listed government funding as a separate source of subsidy. However, the method by which a government subsidy is financed will make that source more, or less, like a traditional cross-subsidy. For example, if a federal subsidy is financed through general tax revenues that are largely derived from income taxes, that source has little in common with a traditional cross-subsidy. In contrast, if the subsidy is financed by a tax on a specific service (such as long-distance telecommunications), it has some of the characteristics similar to traditional cross-subsidies.⁴² In general, the broader-based the tax, the less the tax distorts economic efficiency and the behavior of market participants.⁴³ If service-specific taxes or price increases are employed, it is more efficient to apply them to the services which are least price-sensitive.⁴⁴

Before discussing government subsidies in more detail, it is first useful to note that governments tend to intervene in markets when unsatisfied with the free market result. In some instances, government intervention can take

William B. Shew, *Current Issues in Telecommunications Regulation: Pricing*, 4 YALE J. ON REG. 191, 211–12 (1994); Steve G. Parsons, *Seven Years After Kahn and Shew: Linger Myths on Costs and Pricing Telephone Service*, 11 YALE J. ON REG. 149, 164–65 (1994).

⁴⁰ This is the description on the voluntary line item on the monthly Ameren bill. See *Warm Neighbors Cool Friends*, AMEREN ILL., <https://www.ameren.com/illinois/company/community/warm-neighbors-cool-friends> (last visited Mar. 21, 2020).

⁴¹ See PELTZMAN & WINSTON, *supra* note 9.

⁴² A service-specific tax has an effect similar to that of a simple increase in the price of the service. It influences customer behavior based upon the own-price elasticity of demand of the service and it affects economic efficiency in that sector.

⁴³ See, e.g., Alan J. Auerbach & James R. Hines Jr., *Taxation and Economic Efficiency*, in 3 HANDBOOK OF PUBLIC ECONOMICS 1347 (Alan J. Auerbach & Martin Feldstein eds., 2002).

⁴⁴ This is called "Ramsey Pricing" by economists and applies to situations in which the margins above costs are inversely proportional to the own-price elasticity of the service. This principle was initially discussed by Frank P. Ramsey, *A Contribution to the Theory of Taxation*, 37 ECON. J. 47, 47–61 (1927). This idea was later independently discussed in M. Boiteux, *On the Management of Public Monopolies Subject to Budgetary Constraints*, 3 J. ECON. THEORY 219, 219–240 (1971).

the form of government provided services (for example, the United States Postal Service or the Social Security Administration), in which the service is largely (or completely) funded by user fees or taxes that approximate a user fee. In other instances, the provision of a service, such as national defense, occurs largely without user fees. Other services are provided largely by private parties, but funded by government agencies (such as Medicare and Medicaid). In still other instances, intervention can take the form of payments to people based on income, largely for the purposes of redistributing income (for example, Aid to Families with Dependent Children).⁴⁵

Government intervention can also take the form of antitrust intervention for specific industries or firms. Often, the intervention is generic across industry, such as rules for health and safety, labeling, providing information, or treatment of employees (for example, required employee benefits for employees working over thirty-two hours per week). In some instances, government programs directly change the prices for certain services (such as price supports in agriculture, minimum wage laws, and rent control laws). In other circumstances, intervention takes the form of explicitly subsidizing a service (for example, in the case of basic residential telephone service in the United States), subsidizing a segment of customers for a specific service (for example, United States “Link-up” and “Life-line” services for low-income telecommunications customers),⁴⁶ or subsidizing certain geographic areas (such as in the case of modern universal service policies for telecommunications or broadband networks).

In every instance where a subsidy is warranted, the free market result would lead to lower volumes of service, higher prices for services, or the complete absence of service in some geographic areas, particularly low-income and rural areas. Given the above potential free market results and government reactions, intervention is often deemed appropriate depending upon the government policy in each respective circumstance.

VI. OWNERSHIP, REGULATION, AND SUBSIDIES

With most industries, forms of ownership have important implications for economic regulation (for example, regulation of rate of return, prices, entry and exit). Publicly owned and operated endeavors, such as the United States Post Office, are generally not regulated per se. Rather, it is expected that the relevant legislative and administrative governmental bodies control the enterprise and establish guidelines that serve the public interest. At the other extreme, for-profit businesses may face economic regulation if they have (1) significant market power (the ability to control price), (2) a “natural monopoly” (a downward-sloping average total cost in the relevant range of the total market), or (3) a large share of the relevant market in which they

⁴⁵ The Aid to Families with Dependent Children was replaced by other programs in 1996. See *Aid to Families with Dependent Children*, WIKIPEDIA (Mar. 26, 2021, 3:33 PM), https://en.wikipedia.org/wiki/Aid_to_Families_with_Dependent_Children (last visited Dec. 5, 2019).

⁴⁶ *High-Cost Universal Service Support*, F.C.C. 08-262 (2008) (Order on Remand and Report and Order and Further Notice of Proposed Rulemaking).

operate.⁴⁷ If the firm is not regulated, these characteristics will likely draw the scrutiny of antitrust authorities.⁴⁸ In some instances, both regulation and antitrust remedies are applied.⁴⁹

Not-for-profit institutions stand between public institutions and private firms. Some rely primarily on philanthropic donations, while others are “cooperatives,” in which customers are the shareholders of the not-for-profit organization. There are legal constraints on the behavior of not-for-profit organizations.⁵⁰ However, not-for-profit organizations generally do not face economic regulation, especially not in the form of price control, nor do they generally face antitrust enforcement. The lack of economic regulation and antitrust scrutiny is likely due to the inability of these firms to profit from an abuse of market power. Indeed, traditional rate-of-return regulation sought to establish prices such that each not-for-profit firm could recover its costs, including a typical (risk-adjusted) return on its investments.⁵¹

While antitrust and economic regulation are generally not applied to not-for-profit organizations, such firms must still employ business practices that approximate the behavior of for-profit organizations. They must, in the long run, also avoid losses. Such firms will generally avoid NPV negative investments and will tend to fund the high internal rate of return investment opportunities first.

Cross-subsidies for public companies are subject to economic constraints as well. In theory, a public enterprise could subsidize a service (such as telecommunications local land-line access in the twentieth century) or a segment (such as residential customers or rural customers) either through tax revenues, or cross-subsidization with higher prices for other non-subsidized services. As a practical matter, it appears that public enterprises in network industries do not typically use general tax revenues as a method by which to subsidize services or segments.

In Sections IV–V, we argued that for-profit firms will not knowingly and willingly subsidize services or segments.⁵² Such activities, by definition, reduce total profits. We also suggested that not-for-profit firms cannot engage in such activities frequently and their ability to do so will depend on the profitability of the services or segments that are providing the source of

⁴⁷ See, e.g., ALLEN ET AL., *supra* note 17; ALFRED E. KAHN, *THE ECONOMICS OF REGULATION: PRINCIPLE AND INSTITUTIONS* (1970); FREDERIC M. SCHERER, *INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE* (Houghton Mifflin, 2d ed. 1980).

⁴⁸ See ROBERT H. BORK, *THE ANTITRUST PARADOX: A POLICY AT WAR WITH ITSELF* (Free Press, 2d ed. 1993); *The Antitrust Laws*, FED. TRADE COMM’N, <https://www.ftc.gov/tips-advice/competition-guidance/guide-antitrust-laws/antitrust-laws> (last visited Apr. 2, 2021).

⁴⁹ Arguably the most extreme antitrust remedy in United States history was the breakup of the regulated enterprise AT&T (effective January 1, 1984) into eight separate entities, seven of which would continue to be “rate-of-return” regulated for some period. For a discussion of the early impacts of the divestiture of AT&T, see generally Paul W. MacAvoy & Kenneth Robinson, *Winning by Losing: The AT&T Settlement and its Impact on Telecommunications*, 1 YALE J. ON REG. 1, 2–9 (1984); Paul W. MacAvoy & Kenneth Robinson, *Losing by Judicial Policymaking: The First Year of the AT&T Divestiture*, 2 YALE J. ON REG. 225, 228–30 (1985).

⁵⁰ See Jeremy Barlow, *Government Regulations for Nonprofit Organizations*, BD. EFFECT (Mar. 6, 2017), <https://www.boardeffect.com/blog/government-regulations-nonprofit-organizations>; Noel Diem, *Non-Profit Organizations: What are the Rules?*, L. ST. MEDIA (Apr. 8, 2015), <https://legacy.lawstreetmedia.com/issues/law-and-politics/non-profit-organizations-rules>.

⁵¹ See, e.g., Kahn & Shew, *supra* note 39, at 240.

⁵² It is possible that single-price programs, such as advertising service in an entire geographic area for a single price, can lead to a something akin to cross-subsidy.

subsidy. In this sense, regulated for-profit firms and not-for-profit firms are similar.

While most network industries have similarities among them, specific network industries are affected by their own nuanced differences and economic characteristics. Each of the network industries we consider has a different mix of ownership. Network industries in the United States generally have a longer history of private ownership than they have in other countries. Outside of the United States, many industries—especially network industries—were nationalized in the early part of the twentieth century. Additionally, there was some tendency for the nationalized entities to be privatized and partially deregulated in the last two decades of the twentieth century.⁵³

Telecommunications is an example of an industry with differences in ownership between the United States and outside the United States. “One of the most distinctive characteristics of the U.S. telephone system is that it has always been privately owned, in stark contrast to the pattern of government ownership followed by virtually every other nation.”⁵⁴ Beginning in the mid-twentieth century, firms in the United States were primarily rate-of-return regulated, with the nature and degree of the regulation diminishing over time.

The electric power industry in the United States has a mix of ownership. The federal government has some involvement in electric power generation and transmission. The Tennessee Valley Authority is a federally owned corporation primarily engaged in electric power generation and transmission providing services in portions of seven states.⁵⁵ The Federal Army Corps of Engineers has hydro-electric power generating facilities and associated transmission facilities across the United States. Municipally owned electric power companies provide electric power distribution (and some generation and transmission) primarily in the more densely populated portions of the United States.⁵⁶

Investor-owned electric power companies are involved in generation, transmission, and distribution. “[T]he electric power industry generally evolved from being unregulated, to being regulated first by municipalities, then states, and then the federal government.”⁵⁷ These firms were generally rate-of-return regulated in all their vertical segments during most of the

⁵³ See *List of Nationalizations by Country*, WIKIPEDIA (Mar. 6, 2021, 1:06 AM), https://en.wikipedia.org/wiki/List_of_nationalizations_by_country; *Regulatory Reform in Network Industries: Past Experience and Current Issues*, 67 OECD ECON. OUTLOOK 152, 154 (2000), <http://www.oecd.org/economy/outlook/2087321.pdf>; EUR. COMM’N, EUROPEAN ECONOMY: MARKET FUNCTIONING IN NETWORK INDUSTRIES 17, 20 (2013), https://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp129_en.pdf; MEHMET UGUR, LIBERALISATION OF NETWORK INDUSTRIES IN THE EUROPEAN UNION: EVIDENCE ON MARKET INTEGRATION AND PERFORMANCE (2007), <http://aei.pitt.edu/8053/1/ugur-m-05a.pdf>.

⁵⁴ Michael A. Janson & Christopher S. Yoo, *The Wires Go to War: The U.S. Experiment with Government Ownership of the Telephone System During World War I*, 91 TEX. L. REV. 983 (2013).

⁵⁵ See *Tennessee Valley Authority*, WIKIPEDIA (Mar. 27, 2021, 7:58 PM), https://en.wikipedia.org/wiki/Tennessee_Valley_Authority.

⁵⁶ For more information, see generally AM. PUB. POWER ASS’N, <https://www.publicpower.org/> (last visited July 30, 2020); *Category: Municipal Electric Utilities of the United States*, WIKIPEDIA (Sept. 7, 2019, 8:47 PM), https://en.wikipedia.org/wiki/Category:Municipal_electric_utilities_of_the_United_States.

⁵⁷ DAVID P. TUTTLE ET AL., THE FULL COST OF ELECTRICITY (FCE-): THE HISTORY AND EVOLUTION OF THE U.S. ELECTRICITY INDUSTRY 5 (2016), http://sites.utexas.edu/energyinstitute/files/2016/09/UTAustin_FCe_History_2016.pdf.

twentieth century at the federal level via the Federal Power Act of 1935. At the state level, these utilities were regulated via statutes creating Public Utility Commissions, which also regulated telephone companies and, in some instances, other network industries.

“Wholesale” (generation and transmission) electric power segments saw reduced regulation at the federal level via the Energy Policy Act of 1992 while state-level regulation now varies.⁵⁸ The Act eliminated obstacles for wholesale electricity competition, but this deregulation has yet to be introduced to all states.⁵⁹ Substantial regulation of electric power distribution, and associated retail activities, continues today. However, these regulated investor-owned firms tend not to serve the most rural portions of the United States, which are less profitable due to economies of linear density. Electric power in rural America is dominated by not-for-profit cooperatives. More than 900 cooperatives in forty-seven states provide electric service to 56% of the nation’s landmass.⁶⁰ This represents less than 5% of the United States population.⁶¹

Road networks are dominated by public ownership and operation, although private companies may be contracted to construct or maintain these public roads. There are relatively few private toll roads in the United States compared to other nations in the world. When highways began being developed, tolls had to be collected by human cashiers at toll booths as electronic systems did not exist. This additional operation cost, along with the upfront investments and road maintenance, created a business model that could only be covered by large volumes of traffic. Therefore, some highways were not profitable and had to shut down or be turned over to the government. Today, private toll roads exist in places such as Alabama (the Foley Beach Express), Alaska (the Dalton Highway), California (which has four private highway franchises), Colorado (the Super Slab), Florida (the Orchard Pond Parkway), Illinois (the Chicago Skyway), Indiana (the Indiana Toll Road), Texas (the Trans-Texas Corridor), and Virginia (the Dulles Greenway).⁶²

Water networks and sewer networks are also dominated by public ownership and operation. However, as we note in Section XII, these networks are virtually non-existent in the most rural portions of the United States.

⁵⁸ For a map of states by regulatory status, see PURDUE UNIV., ELECTRIC UTILITIES, DEREGULATION AND RESTRUCTURING OF U.S. ELECTRICITY MARKETS, <https://www.purdue.edu/discoverypark/energy/assets/pdfs/History.pdf> (last visited July 30, 2020). See also *Deregulation*, WIKIPEDIA (Mar. 29, 2021, 6:42 AM), <https://en.wikipedia.org/wiki/Deregulation>.

⁵⁹ As of April of 2014, sixteen states have introduced deregulated electricity markets to consumers in some capacity (Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, Montana, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, and Texas). *Electricity Deregulation Map*, ELECTRICITY LOCAL (Apr. 2014), <https://www.electricitylocal.com/resources/deregulation/>.

⁶⁰ *Electric Co-op Facts & Figures*, NRECA (June 23, 2020), https://www.electric.coop/wp-content/uploads/2020/06/Coop_FactsAndFigures_June2020.pdf.

⁶¹ See *Rural Telecommunications Cooperatives*, UW CTR. FOR COOPERATIVES (last visited July 30, 2020), <https://mce.uwcc.wisc.edu/utilities-overview/rural-telecommunications-cooperatives/> (stating that rural telephone cooperatives “serve less than 5% of the nation’s telecom subscribers through coverage of over 40% of the nation’s landmass.”).

⁶² See *Private Highways in the United States*, WIKIPEDIA (Dec. 24, 2020, 9:33 PM), https://en.wikipedia.org/wiki/Private_highways_in_the_United_States.

Airline networks in the United States are an interesting mix of public and for-profit ownership. Airports have a greater potential for abuse of market power than airline services. As such, airports in the United States are virtually all publicly owned. In contrast, airlines in the United States are virtually all for-profit private entities. These airlines were regulated via the Civil Aeronautics Act and then largely deregulated in 1977 and 1978. Prior to deregulation, subsidies to rural areas occurred through regulatory-mandated cross-subsidization. Subsequent to deregulation, the cross-subsidies were replaced (at least in part) by federally funded subsidies discussed in more detail in Section X.

The communications sector in the United States has been dominated by for-profit organizations. These networks were not built by the government, but by private investors with private capital.⁶³ While some publicly-owned or cooperatively-owned phone companies have existed, they have been a small proportion of the population. Cooperatives are more likely to exist in rural areas of the United States.⁶⁴ There are 260 telephone cooperatives—consumer-owned utilities established to provide telecommunications services at a reasonable cost—in the United States. Currently, cooperatives provide telecommunication services to approximately 1.2 million rural Americans in thirty-one states. They serve a very small proportion of the nation's telephone subscribers (5%), but the service area they cover is over 40% of the country's land mass.⁶⁵ And in a new twist, electric cooperatives have started deploying broadband networks within their electric service footprint.

In recent years, municipally owned broadband-based networks that also provide telecommunications services have arisen with a variety of revenue-support mechanisms, including the use of general funds and property taxes.⁶⁶ However, there are a number of states that preclude municipal-owned networks in part based upon the potential for crowding out tax-generating private investment.⁶⁷ Telecommunications subsidies are discussed in more detail in the following section.

VII. TELECOMMUNICATIONS SUBSIDIES: A BRIEF HISTORY

Telecommunication subsidies have a long history, based in large part upon the market power of the primary vertically-integrated incumbent (AT&T and the Bell System); the regulation of that incumbent; and the Communications Act of 1934, modified under the Telecommunications Act

⁶³ See Norbert Michel & James Gattuso, *Are U.S. Telecom Networks Public Property?*, HERITAGE FOUND. (Apr. 8, 2004), <https://www.heritage.org/technology/report/are-us-telecom-networks-public-property>.

⁶⁴ For example, the Cooperative Telephone Company, founded in 1956, was designed to serve the communities of Guernsey, Hartwick, Ladora and Victor, Iowa. It is a “non-profit cooperative owned by [their] member-owners and [is] proud to offer [their] customers local telephone service as well as Internet, video and wireless offerings.” See generally THE COOPERATIVE TELEPHONE COMPANY, <https://www.cooperativetelephone.com/> (last visited July 30, 2020).

⁶⁵ See *Rural Telephone Cooperatives*, UNIV. WIS. CTR. FOR COOPERATIVES, <http://reic.uwcc.wisc.edu/telephone/default.htm> (last visited July 30, 2020).

⁶⁶ See *Community Network Map*, INST. FOR LOC. SELF-RELIANCE, <https://muninetworks.org/communitymap> (last visited July 30, 2020).

⁶⁷ For a map of such states, see *id.*

of 1996,⁶⁸ which established principles for universal service that specifically focused on increasing access to consumers living in rural and insular areas, and for consumers with low incomes. Over time, certain services and segments of services became cross-subsidized by other services. By the last half of the twentieth century, the pattern of cross-subsidization in both the United States and much of the world was: (1) from business to residence; (2) from high-usage (especially “long distance”) to low-usage; and (3) from urban to rural.⁶⁹ This occurred in part via a complex web of revenues “settlements” processes, where revenues were distributed back to local exchange companies, as well as allocations of a portion of the non-traffic sensitive costs of the local exchange to the interstate jurisdiction.⁷⁰ These subsidies were possible due to the status of incumbents as franchise-protected monopoly providers. Note that each of the cross-subsidy patterns tended to cross-subsidize rural areas since rural areas tend to be populated by low-usage, high cost residential customers. However, after the divestiture of AT&T (effective in 1984) and the expansion of competition in most segments of the industry, these patterns of cross-subsidy became increasingly difficult to manage and competitively unsustainable.

The FCC’s Telecommunications Act of 1996⁷¹ first universal service order stated:

The [1996 Telecommunications] Act also recognizes, however, that universal service cannot be maintained without reform of the current subsidy system. The current universal service system is a patchwork quilt of implicit and explicit subsidies. These subsidies are intended to promote telephone subscribership, yet they do so at the expense of deterring or distorting competition.⁷²

In order to maintain the public policy objectives in the communications industry (primarily universal service objectives to provide reasonable services everywhere at affordable prices), the traditional patterns of cross-subsidies are in the process of being replaced with explicit subsidies, as seen in the FCC’s universal service support system, with four types of

⁶⁸ See Communications Act of 1934, 47 U.S.C. § 151 (1934).

⁶⁹ See Parsons, *supra* note 37, at 176; see also David L. Kaserman & John W. Mayo, *Cross-subsidies in Telecommunications*, 11 YALE J. ON REG. 119, 131 (1994); BRIDGER M. MITCHELL & INGO VOGELSANG, *TELECOMMUNICATIONS PRICING THEORY AND PRACTICE* 118–136 (1991); COUNCIL ECON. ADVISERS, *ECONOMIC REPORT OF THE PRESIDENT* 177 (1996), <https://www.presidency.ucsb.edu/sites/default/files/books/presidential-documents-archive-guidebook/the-economic-report-of-the-president-truman-1947-obama-2017/1996.pdf> (stating that “[f]or many years regulators, with the support of Congress, used cross-subsidies between regulated monopolists to pursue universal service goals. Through a complicated nationwide pooling of telephone costs and revenues, local telephone companies especially in high-cost rural areas, received substantial subsidies to keep their rates low.”).

⁷⁰ See generally *Smith v. Illinois Bell Telephone Co.*, 282 U.S. 133 (1930) (requiring state regulators to allocate local access charges to telephone companies based on interstate versus intrastate use of the exchange). Later, through complicated dealings and negotiations with the FCC and AT&T, state regulators began to shift more of the costs of intrastate service to interstate service. See CHRISTOPHER H. STERLING ET AL., *SHAPING AMERICAN TELECOMMUNICATIONS: A HISTORY OF TECHNOLOGY, POLICY AND ECONOMICS* 101–04 (2006).

⁷¹ See Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56 (1996).

⁷² *Federal-State Joint Board on Universal Service*, F.C.C. 96-325, 15506 (May 8, 1997).

mechanisms:⁷³ (1) high-cost support,⁷⁴ (2) low-income support,⁷⁵ (3) rural healthcare support,⁷⁶ and (4) schools and libraries support mechanism.⁷⁷

VIII. UNITED STATES ROAD NETWORK SUBSIDIES

Economies of density apply to road networks as well; the costs per user-mile (a measure of both the road miles and the number of citizens driving over those road miles in a given time period) are lower for more highly traveled roads (which are generally found in more densely populated areas). At first glance, user fees for road networks would seem to only apply to toll roads. However, taxes on motor fuel create indirect user fees (or an approximation to user fees). One can think of these taxes as sources of revenue from road usage of approximately \$0.50 per gallon for federal and state taxes combined.⁷⁸ Federal motor fuel taxes were over \$43.8 billion in 2015,⁷⁹ while we estimate that state motor fuel taxes that year were over \$65 billion.⁸⁰ Low population-density areas have a smaller number of drivers per road mile and therefore generate lower revenue per road mile. Through these taxes, drivers in high linear density areas essentially cross-subsidize drivers in low-density areas via the much higher gasoline taxes paid per road mile in high linear density areas.

Road construction and repairs are financed in part through state, county, and local taxes. As noted in Section V, such financing is less akin to a traditional cross-subsidy. Because of economies of density, the subsidy per user-mile will be particularly high in rural areas. According to the Federal Highway Administration, the United States has approximately 4.18 million miles of roads, of which 2.94 million miles are in rural areas.⁸¹ However, the clear majority of user miles (and taxpayer locations) are on non-rural roads.

⁷³ *Universal Service Fund*, FCC, <https://www.fcc.gov/general/universal-service-fund> (last visited July 30, 2020).

⁷⁴ *See id.* (stating that the Universal Service Fund “provides support to certain qualifying telephone companies that serve high cost areas, thereby making phone service affordable for the residents of these regions.”).

⁷⁵ *See id.* (stating that the Universal Service Fund “assists low-income customers by helping to pay for monthly telephone charges as well as connection charges to initiate telephone service.”).

⁷⁶ *See id.* (stating that the Universal Service Fund “allows rural health care providers to pay rates for telecommunications services similar to those of their urban counterparts, making telehealth services affordable.”).

⁷⁷ *See id.* (stating that the Universal Service Fund “popularly known as the ‘E-Rate,’ provides telecommunication services (e.g., local and long-distance calling, high-speed lines), Internet access, and internal connections (the equipment to deliver these services) to eligible schools and libraries.”).

⁷⁸ Federal gas and gasoline taxes are \$0.184/gallon and diesel taxes are \$0.244/gallon. Federal taxes also apply to heavy trailers and tires beyond a certain pressure. *See* U.S. DEPT. OF TRANSP., *Ask the Rambler*, HIGHWAY HIST. (June 27, 2017), <https://www.fhwa.dot.gov/infrastructure/gastax.cfm>. Weighted average state fuel taxes are approximately \$0.31/gallon. *See Fuel Taxes in the United States*, WIKIPEDIA, https://en.wikipedia.org/wiki/Fuel_taxes_in_the_United_States (last visited Apr. 2, 2021); *see also Highway Statistics 2017*, U.S. DEPT. TRANSP. FED. HIGHWAY ADMIN. (Aug. 23, 2018), <https://www.fhwa.dot.gov/policyinformation/statistics/2017/hm16.cfm>; *Frequently Asked Questions*, AM. ROAD & TRANSP. BUILDERS ASS’N, <https://www.artba.org/about/faq> (last visited July 30, 2020).

⁷⁹ *See Motor Fuel Tax Revenue*, TAX POL’Y CTR. (Jun. 18, 2020), <http://www.taxpolicycenter.org/statistics/motor-fuel-tax-revenue>.

⁸⁰ This is estimated as a lower bound using the ratio of state and federal fuel taxes per gallon.

⁸¹ *See also Highway Statistics 2017*, *supra* note 78; *Frequently Asked Questions*, *supra* note 78.

IX. ELECTRIC POWER DISTRIBUTION SUBSIDIES

The electric power industry is generally considered to have four vertical segments: generation, transmission, distribution, and retail. Many investor-owned electric power utilities and some of the larger public power providers are vertically-integrated into each of these segments. Smaller utilities may only provide distribution and retail (including billing, customer service, and customer acquisition). Electric power distribution has generally been considered to be a natural monopoly, in part due to economies of density. The industry, filled with explicit subsidization of electric power service in rural areas, has a long history in the United States. The Rural Electrification Act of 1936⁸² established the Rural Electrification Administration, whose purpose was to create jobs and boost rural deployment and economies by providing grants and loans to rural electric cooperatives. Through this effort, virtually all urban and suburban residents had access to electric power and even 99% of all rural homes had electricity by 1975.

Today, the United States Department of Agriculture (“USDA”) Rural Development’s Rural Utilities Service (“RUS”) oversees federal subsidy programs, loans, and loan guarantee programs for rural water, waste disposal, electric power, telecommunications, distance learning, telemedicine and broadband, and high-energy cost grants, among other programs. According to the most recent USDA Rural Development progress report, RUS awarded a total of \$38.34 billion to the “electric” programs between fiscal year 2009 and 2016.⁸³ RUS loans and subsidies through the Electric Infrastructure Loan and Loan Guarantee Program⁸⁴ (“EILP”) provide loans and loan guarantees for the construction, maintenance, and expansion of electric transmission and distribution systems. EILP offers up to a 100% loan guarantee from the Federal Financing Bank (“FFB”) for credit towards construction work as well as hardship loans. The EILP serves as the main loan and subsidy program under RUS. EILP funding is available for use in the transmission, distribution, and generation processes of the electric system. The authorization for the FFB for loans for each fiscal year since 2006 averages over \$6 billion per year, as follows:

Table 1: Federal Financing Bank Loans by Fiscal Year (in \$ Billions)

Year	2005	2006	2007	2008	2009	2010	2011	2012
Loan	4.32	5.39	5.39	7.10	6.60	7.10	7.10	7.00

Table 1 (Continued)

Year	2013	2014	2015	2016
Loan	7.10	5.50	5.00	5.00

In addition, the Energy Efficiency and Conservation Loan Program (“EECLP”)⁸⁵ provides loans at Treasury interest rates to rural utility service providers who are current borrowers. This funding encourages the use of

⁸² 7 U.S.C. §§ 901 et seq. (1936).

⁸³ See USDA RURAL DEV., 2016 PROGRESS REPORT (2017), https://www.giaging.org/documents/USDA_Rural_Dev_ProgressReport2016.pdf.

⁸⁴ See Rural Electrification Act of 1936, Pub. L. No. 74-605, § 313A, 49 Stat 1363 (1936); see also 75 C.F.R. § 42571 (2010).

⁸⁵ See 7 U.S.C.S. § 904 (1936); see also 7 C.F.R. § 1710(h) (2013).

renewable energy fuels or reduced use of fossil fuel within the service territory.

Finally, it should be noted that Electric Power Distribution companies generally face no facilities-based competitors, especially in rural areas. As such, compared to companies in competitive markets, Electric Power Distribution companies have greater certainty to recover the costs incurred in deploying infrastructure, including the repayment of financing packages such as those described above. Additionally, this protected network investment can form the basis of cross-industry expansion. The competitive implications of cross-industry expansion are discussed later in this Article, in the section entitled “Economies of Scope”.

X. AIRLINE SUBSIDIES IN THE UNITED STATES

Airlines also comprise a network industry with nodes (airports) and links (flights connecting the airports). Airlines are different from most other networks in at least two respects. First, in the United States, virtually all nodes are government-owned.⁸⁶ Second, the capital investment required to connect airports is fungible: an aircraft can be moved to a different link easily.⁸⁷

The airline industry was regulated by the Civil Aeronautics Act (“CAA”), enacted in 1938, which created the Civil Aeronautics Board (“CAB”).⁸⁸ The CAB was created with the status of an independent regulatory agency and the authority to control entry and exit in total and by route, award subsidies, control mergers, regulate fares,⁸⁹ and control deceptive and unfair trade practices.

Under regulation, unprofitable, low-demand, short-haul (often to smaller rural airports) routes were cross-subsidized by high-demand, long-haul, highly profitable routes between larger city pairs. “Subsidy to firms was provided under the CAA on an aggregate basis, where profits from more dense routes were supposed to support losses from less dense routes, with the government making up any aggregate shortfall.”⁹⁰

Significant regulatory changes occurred in the industry with the Air Cargo Act of 1977⁹¹ and Airline Deregulation Act of 1978.⁹² With

⁸⁶ The exception is the Branson Airport. See *Branson Airport*, WIKIPEDIA (Oct. 20, 2020, 2:09 AM), https://en.wikipedia.org/wiki/Branson_Airport. Some economists suggest private ownership of airports would be welfare-improving. See, e.g., Robert W. Poole Jr. & Chris Edwards, *Privatizing U.S. Airports*, CATO INST. (Nov. 21, 2016), <https://www.cato.org/publications/tax-budget-bulletin/privatizing-us-airports>.

⁸⁷ One might be tempted to include broadcast television and mobile communications networks in this category. However, transmission distance limitations cause the “link” investments in these industries to be specific to geographic areas (even if they are not specific to a route, as in electric power networks). Satellite communications “link” investments are more fungible, meaning they are more like airlines and connection capacity can be re-assigned to different geographic areas.

⁸⁸ See Civil Aeronautics Act, 75 Pub. L. No. 75-706, 52 Stat. 973, Ch. 601 (1938).

⁸⁹ The CAB also regulated the commissions airlines paid travel agents. See, e.g., ELIZABETH E. BAILEY ET AL., *DEREGULATING THE AIRLINES* 59 (1985).

⁹⁰ Michael E. Levine, *Regulation and Nature of the Firm: The Case of U.S. Regional Airlines*, 54 J.L. & ECON. 229, 232 (2011); see also Lawrence J. White, *U.S. Public Policy Toward Network Industries* (NYU Ctr. L. & Bus., Working Paper No. 98-019, 1997); Severin Borenstein, *The Evolution of U.S. Airline Competition*, 6 J. ECON. PERSPS. 45, 47 (1992) (stating “[o]n the shorter routes, which had been cross-subsidized under regulation . . .”).

⁹¹ See Air Cargo Act, Pub. L. No. 95-163, 91 Stat. 1286 (1977).

⁹² See Airline Deregulation Act, Pub. L. No. 95-504, 92 Stat. 1705 (1978).

deregulation came two concerns with respect to rural areas: (1) that some airports might be abandoned by commercial carriers and (2) that prices to consumers at smaller airports would rise. Congress responded to these concerns by creating the Essential Air Service (“EAS”) program,⁹³ modified their response through the Department of Transportation and Related Agencies Appropriations Act of 2000,⁹⁴ and again through the FAA Modernization and Reform Act of 2012.⁹⁵ Over time, the need for subsidies to small airports and the carriers serving them has changed in response to fuel prices, price and availability of more efficient smaller aircrafts, and general economic conditions (particularly the recession in 2008).⁹⁶

Automobile and land-based public transit are substitutes for air travel. Therefore, EAS subsidies are limited to \$200/passenger (less than 210 miles to a large/medium hub airport), and \$1000/passenger (more than 210 miles to a large/medium hub airport).⁹⁷ Moreover, EAS subsidies are different for Alaskan airports.

While it is impossible to quantify the cross-subsidies during regulation, the explicit subsidies under the EAS and Small Community Air Service Development Grant (“SCASDG”) programs are quantifiable. *Table 2* below illustrates the total subsidies and the count of communities receiving subsidies. As seen in the table, the count of subsidized communities grew somewhat over time, while the total dollar value of subsidies received grew substantially at over \$300 million annually by 2018 and totaling over \$3.5 billion since its inception in 1986.

⁹³ Congress responded to such concerns by adding Section 419 to the Federal Aviation Act in 1978, amended as 49 U.S.C 41731–41742 in June of 1994. *See generally Essential Air Service*, U.S. DEP’T TRANSP. (Nov. 22, 2017), <https://www.transportation.gov/policy/aviation-policy/small-community-rural-air-service/essential-air-service>.

⁹⁴ *See* Department of Transportation and Related Agencies Appropriations Act, Pub. L. No. 106-69, 105 Stat. 1943-1945 (2000).

⁹⁵ *See* 49 U.S.C. § 41731(a)(1)(B).

⁹⁶ Michael D. Wittman, *Public Funding of Airport Incentives: The Efficacy of the Small Community Air Service Development Grant Program*, 35 TRANSP. POL’Y 220, 222 (2014).

⁹⁷ *See* 49 U.S.C § 41731–41742 (approved Dec. 2020); *see Small Community Air Service Development Program (SCASDP)*, U.S. DEP’T TRANSP. (Jan. 19, 2021), <https://www.transportation.gov/policy/aviation-policy/small-community-rural-air-service/SCASDP>. This program allows for no more than four grants per state.

Table 2: Report on EAS Subsidies in Alaska and Non-Alaskan States⁹⁸

Year	Annual Contract Subsidy Rates (Total, Non-Alaska)	Count of Communities Served (Non-Alaska)	Annual Contract Subsidy Rates (Total Alaska)	Count of Communities Served (Alaska)
2018	\$293.6 M	111	\$22.9 M	63
2017	\$277.3 M	112	\$21.3 M	61
2016	\$267.1 M	113	\$20.9 M	61
2015	\$249.3 M	115	\$15.5 M	49
2014	\$238.5 M	116	\$15.2 M	43
2013	\$219.9 M	117	\$14.7 M	43
2012	\$224 M	120	\$14.1 M	43
2011	\$176 M	109	\$13.9 M	44
2010	\$163 M	109	\$12.6 M	44
2009	\$151.8 M	107	\$12.4 M	45
2008	\$141.3 M	105	\$10.2 M	43
2007	\$100.7 M	102	\$9.3 M	39
2006	\$97.3 M	115	\$9.5 M	39
2005	\$91.7 M	114	\$9.3 M	36
2004	\$82.7 M	105	\$8.9 M	33
2003	\$79.6 M	102	\$7 M	33
2002	\$70 M	92	\$6.5 M	34
2001	\$56.3 M	81	\$3.9 M	33
2000	\$48.2 M	86	\$2.4 M	31
1999	\$44.2 M	79	\$1.8 M	29
1998	\$39.7 M	71	\$1.9 M	26
1993	\$35.7 M	101	\$1.7 M	30
1992	\$30.5 M	86	\$1.3 M	31

⁹⁸ Please note that the Department of Transportation did not formally report on EAS expenditures for the years 1989-1991 and 1994-1997. However, other sources have reported on approximations of these expenditures. In 1989, 1990, and 1991, respectively, total (Alaskan and non-Alaskan) EAS expenditures were approximately \$30 million, \$29 million, and \$27 million dollars. In 1994, 1995, 1996 and 1997, respectively, total (Alaskan and non-Alaskan) EAS expenditures were approximately \$30 million, \$31 million, \$22 million, and \$25 million. See RACHEL Y. TANG, CONG. RSCH. SERV., R44176, ESSENTIAL AIR SERVICE (EAS) (2018), <https://fas.org/sgp/crs/misc/R44176.pdf>.

Table 2: Report on EAS Subsidies in Alaska and Non-Alaskan States⁹⁸

Year	Annual Contract Subsidy Rates (Total, Non-Alaska)	Count of Communities Served (Non-Alaska)	Annual Contract Subsidy Rates (Total Alaska)	Count of Communities Served (Alaska)
1988	\$24.3 M	107	\$3.5 M	46
1987	\$22.5 M	96	\$2.3 M	83
1986	21 M	97	\$3 M	41
Total Dollars⁹⁹/ Average Count of Communities	\$3,225.5 M	102.6	\$246.2 M	42.4
Source: <i>Current and Historical Status Reports</i> , U.S. DEP'T OF TRANSP., https://www.transportation.gov/office-policy/aviation-policy/essential-air-service-reports (last visited July 30, 2020).				

In 2010, airline subsidies in the United States were augmented through the SCASDG program.¹⁰⁰ *Table 3* illustrates the subsidies from the SCASDG grant program by year. The number of grants per year is statutorily limited to no more than forty grants. As can be seen, the dollar magnitude of these grants is much smaller than the EAS subsidies.

⁹⁹ These figures are excluding the years 1989-1991 and 1994-1997.

¹⁰⁰ See *Small Community Air Service Development Program (SCASDP)*, *supra* note 97; see also Wittman, *supra* note 96.

Table 3: SCASDP Grants Per Year								
Year	2002	2003	2004	2005	2006	2007	2008	2009
Count of grants	40	35	40	37	25	26	15	19
Dollars Granted (\$ Millions)	20.0	19.8	19.9	19.0	9.7	9.0	6.5	6.4
Table 3 (Continued)								
Year	2010	2011	2012	2013	2014	2015	2016	2017
Count of grants	19	29	33	25	16	11	9	16
Dollars Granted (\$ Millions)	7.0	15.0	13.9	11.4	7.0	5.5	5.2	9.9
Source: <i>Small Community Air Service Development Program (SCASDP) Grant Selections Archive</i> , U.S. DEP'T OF TRANSP., https://www.transportation.gov/policy/aviation-policy/SCASDP-Recipient-Archive (last visited July 30, 2020).								

XI. NATURAL GAS DISTRIBUTION

Natural gas distribution (and, to a lesser extent, natural gas transport) exhibits economies of linear density. However, in very low-density high-cost areas, natural gas distribution networks do not exist. This is because, in such areas, one of two forms of substitution exist. First, customers will substitute propane for natural gas. Propane is delivered not by a network of pipes but by propane trucks (typically filling propane storage tanks). Second, customers may choose to have their location rely solely on electric power and wood-burning space heating. Indeed, electric power subsidies reduce the price of electric power which reduces the demand for natural gas.

In the lowest density areas of the United States, there are virtually no natural gas distribution networks. Because of these alternatives, natural gas distribution is not considered essential and virtually no subsidies exist for natural gas distribution in low-density areas.¹⁰¹ This factor increases the demand for electric power in more rural areas.

XII. WATER DISTRIBUTION AND WASTE DISPOSAL SUBSIDIES

Public water distribution systems are a form of a one-way network, with links (pipes) and nodes (interconnections, water sources, and terminal customer locations). Similarly, sewage collection and treatment systems are also composed of one-way networks, but in the reverse direction of water

¹⁰¹ This ignores any implied subsidies created by favorable tax treatment for natural gas production.

distribution networks. Economies of linear density exist in water distribution networks and sewage networks.

However, unlike communications networks, for both water supply and waste disposal, there are non-network alternatives. Although “[t]he majority of people in the United States use water provided by public suppliers” in 2010, “[a]n estimated 44.5 million people, or 14 percent of the population, supplied their own water for domestic use.”¹⁰² Similarly, for sewage systems, “[m]ore than 21 million households in the United States use septic systems—not a public sewer—to trap and filter their toilet waste.”¹⁰³ With an average of 2.58 persons per household,¹⁰⁴ this means that more than 54 million Americans do not use network-based public sewer systems. Moreover, many regions of the United States still have a relatively high proportion of new housing not on network sewer systems.¹⁰⁵

Therefore, in the most rural areas of the United States, non-network alternatives (septic systems and wells)¹⁰⁶ are frequently employed where linear density is simply too low to allow networks to be economically deployed. These alternative systems themselves can receive subsidies, primarily from the U.S. Department of Agriculture (“USDA”). These include subsidies for well water¹⁰⁷ and waste disposal.¹⁰⁸

Despite the alternatives for non-network water and waste disposal, and the subsidies for such individual investments, subsidies are still significant for network-based water and waste disposal systems. USDA grants are available for network-based waste management for communities with a population of under ten thousand persons.¹⁰⁹ USDA programs for waste and water network systems offer grants, loans, and loan guarantees of up to 90%. They are also available to areas with a population under ten thousand based upon median household income and area served.¹¹⁰

¹⁰² *Domestic Water Use*, U.S. GEOLOGICAL SURV.: WATER SCI. SCHOOL, <https://water.usgs.gov/edu/wudo.html> (last visited July 30, 2020) (citing MOLLY A. MAUPIN ET AL., ESTIMATED USE OF WATER IN THE UNITED STATES IN 2010 (2014), <https://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf>).

¹⁰³ Kaye LaFond, *Infographic: America's Septic Systems*, CIRCLE OF BLUE: WATERNEWS (Oct. 16, 2015), <http://www.circleofblue.org/2015/world/infographic-americas-septic-systems/>.

¹⁰⁴ See DAPHNE LOFQUIST ET AL., U.S. CENSUS BUREAU, C2010BR-14, HOUSEHOLDS AND FAMILIES: 2020 (2012), <https://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf>.

¹⁰⁵ See LaFond, *supra* note 103. In 2013, the share of new homes built with septic systems is as follows (by region): New England – 51%; East South Central – 36%; East North Central – 28%; Mid Atlantic – 19%. *Id.*

¹⁰⁶ In the most rural areas, water distribution networks do not exist; rather, these areas are generally supplied by local water supplies (for example, by springs or creeks), as well as small local wells. In some instances, two or more locations may share a single well or proximal water supply. Some low-density locations rely, at least in part, on water delivery trucks.

¹⁰⁷ See U.S. DEP'T OF AGRIC.: RURAL DEV., RURAL DECENTRALIZED WATER SYSTEMS GRANT PROGRAM (2020), https://www.rd.usda.gov/sites/default/files/fact-sheet/RD_FS_RUS_DecimalizedWaterSysGrant.pdf (last visited July 30, 2020) (stating that “[t]erms for loans include one percent fixed interest rate, 20-year maximum term, and an \$15,000 maximum loan per household.”).

¹⁰⁸ See Jessica Mancel, *USDA Announces Funding Available for Septic System Repairs*, U.S. DEP'T OF AGRIC.: RURAL DEV. (Mar. 16, 2017), <https://www.rd.usda.gov/newsroom/news-release/usda-announces-funding-available-septic-system-repairs>; U.S. DEP'T OF AGRIC.: RURAL DEV., INDIVIDUAL WATER AND WASTEWATER GRANTS (2019), https://www.rd.usda.gov/sites/default/files/fact-sheet/508_RD_FS_IndividualWaterWastewaterGrants.pdf.

¹⁰⁹ See U.S. DEP'T OF AGRIC.: RURAL DEV., SOLID WASTE MANAGEMENT GRANTS (2020), https://www.rd.usda.gov/sites/default/files/fact-sheet/508_RD_FS_RUS_SolidWasteMgmtGrants.pdf.

¹¹⁰ See *Water & Waste Disposal Loan & Grant Program*, U.S. DEP'T OF AGRIC.: RURAL DEV., <https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program> (last visited July 30, 2020).

The USDA's rural development budget for 2018 "provides over \$35 billion for financial and technical assistance for the benefit of rural residents."¹¹¹ It is important to note that this budget covers programs beyond those for water and waste treatment.

XIII. THE COSTS OF DELIVERING BROADBAND IN RURAL AREAS IN THE UNITED STATES

In Section III, it was noted that costs can be placed into three categories: (1) common, (2) direct maintenance and customer-related operations, and (3) direct capital costs. In rural areas, while it was noted that the capital burden is higher, maintenance and operations costs are also higher on a per-location basis since many maintenance operations are caused by the existence of physical assets, rather than the usage of those assets (for example, clearing tree limbs from aerial cable for communications or electric power). In addition, since rural areas are often served by smaller companies, the common costs (averaged over customer locations or service counts) tend to also be higher.

The most important distinction between rural and non-rural areas occurs in the direct capital investments required to serve each area. For example, consider the results from CostQuest's fiber-based broadband cost model, run for the entire nation using three density categories: urban, suburban, and rural. The two most important capital investment categories are: (1) conduit and poles (sometimes called structure) and (2) fiber optic cable. These two categories represent approximately two-thirds of the capital investment needed to provide broadband in rural areas. As one would expect, urban areas are the least costly per customer in every dimension. However, even if one only compares suburban and rural areas, the capital investment per customer location for conduit and poles is approximately five times higher in rural areas as compared to suburban areas. For fiber optic cable, the capital investment is approximately four times higher in rural areas as compared to suburban areas. These cost differentials are critical because network industries tend to be very capital-intensive.

If the focus is maintained on the cost of delivering broadband in low-density areas, the results from CostQuest's fiber-based broadband cost model can be used to demonstrate the impact. In *Figure 5*, the uneconomic portions of the country can be seen¹¹² in the yellow, orange, and red shaded areas (where yellow is the least uneconomic, red is the most uneconomic, and orange is in between). Grey areas are unpopulated. Dark green areas are the most likely to be economic and light green areas could be economic with

¹¹¹ U.S. DEP'T OF AGRIC., FY 2018 BUDGET SUMMARY (2018), <https://www.usda.gov/sites/default/files/documents/USDA-Budget-Summary-2018.pdf>.

¹¹² "Uneconomic" represents those areas where the typical monthly costs will exceed the expected revenue.

high customer subscribership. From a land mass viewpoint, the uneconomic area is quite large.

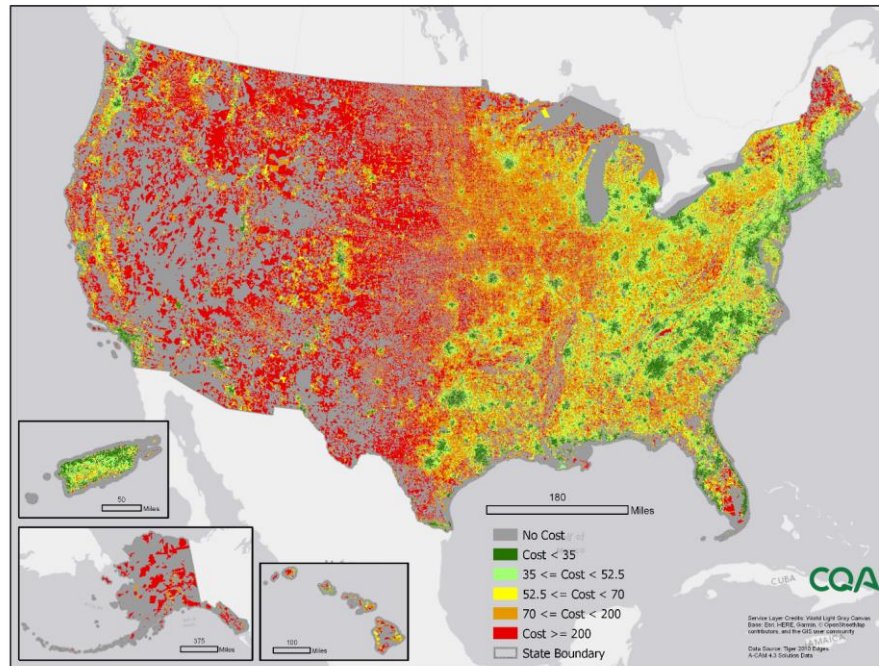


Figure 5: Illustrative View of Uneconomic Areas in the United States¹¹³

The economics of linear density are central to the existence of vast regions of the United States in which it is uneconomical to deploy broadband (in the absence of subsidies of some kind). In *Figure 6*, the average investment required to provide fiber-based broadband service per active household is shown based on the linear density of the Census Block Group where the household is located. The blue dots provide the value when the proportion of households (per household passed) taking service is at 70%. The orange dots show the escalation that occurs when the active service percentage drops in half. For example, with a household “take” rate of 35%, the investment per active subscriber starts to exceed five thousand dollars, a value on the edge of financial viability, at linear density levels of twenty houses per road mile. There are vast regions of the United States with linear density below that level.

¹¹³ The figure is based on output from CostQuest’s Fiber to the Premise Cost Model. Versions of this cost model have been used by industry clients to evaluate network investments and in legal proceedings to set prices. The model has also been used by the FCC to support the National Broadband Plan and to support the distribution of over \$3 billion annually under the Connect America Fund. The model has also been used and accepted in valuation proceedings and used by engineers to design and build fiber networks.



Figure 6: Investment Requirements by Linear Density¹¹⁴

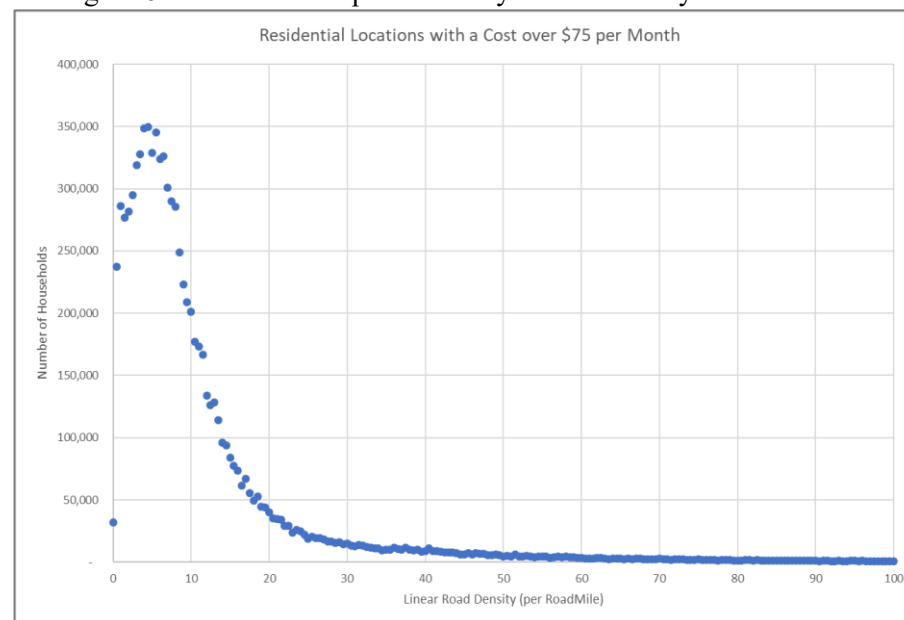


Figure 7: Household Counts with Monthly Cost Exceeding \$75¹¹⁵

In reviewing these figures, it is apparent that large areas of the United States are commercially unviable. Economies of linear density have a significant impact on the economics of deployment of land-based networks.

¹¹⁴ The figure is based on output from CostQuest's Fiber to the Premise Cost Model.

¹¹⁵ The figure is based on output from CostQuest's Fiber to the Premise Cost Model.

XIV. MODERN SUBSIDIES FOR LOW-DENSITY COMMUNICATIONS NETWORKS

As previously described, subsidy requirements in the communication marketplace historically had been addressed by numerous approaches: cross-subsidies from urban areas to rural areas, cross-subsidies from business to residential, cross-subsidies from long-distance charges to local service, federal High Cost Support, RUS grants and low-interest loans, and state Universal Service Fund (“USF”) programs. In recent years, the federal government provided grants for broadband buildout under the Broadband Technology and Opportunities Program (administered by the National Telecommunications & Information Administration)¹¹⁶ and the Broadband Initiatives Program (administered by RUS).¹¹⁷

Communications subsidy programs have changed over time and continue to evolve. This evolution is driven in part by the inability of carriers to maintain internal cross-subsidies in a competitive marketplace and in a marketplace where long-distance revenue (an important historical source of cross-subsidy) has become negligible. In 2011, the FCC announced the Connect America Fund (“CAF”), which was a recommendation of the National Broadband Plan.¹¹⁸ The CAF is a collection of subsidy efforts that overhaul the historical USF funding efforts, including Price-Cap and Rate of Return carrier programs.¹¹⁹ These funds were based on the forward-looking cost of a full-fiber network and were offered to existing carriers of service in specific high-cost areas. The funds are used to support deployment of broadband service in specific high-cost areas. The FCC has followed up on these landline-based funds with a CAF II support auction that occurred in the summer of 2018.¹²⁰ The CAF II auction was for extremely high-cost areas and areas in which the incumbent carrier turned down their initial CAF funding. The auction was a competitive auction open to all eligible telecommunications carriers. In addition to the landline programs, the CAF effort also includes funding for mobility infrastructure.

Communications subsidies also exist via the USDA RUS. These programs include Distance Learning and Telemedicine grants, the Farm Bill

¹¹⁶ See *Broadband Technology Opportunities Program*, U.S. DEP’T OF COM.: NAT’L TELECOMMS. & INFO. ADMIN., <https://www.ntia.doc.gov/category/broadband-technology-opportunities-program> (last visited July 30, 2020) (stating that “[t]he Broadband Technology Opportunities Program (BTOP) is an approximately \$4 billion grant program administered by National Telecommunications & Information Association to help bridge the technological divide; create jobs; and improve education, health care, and public safety in communities across the country. Funded by the American Recovery and Reinvestment Act of 2009, BTOP projects are deploying broadband Internet infrastructure, enhancing and expanding public computer centers, and encouraging the sustainable adoption of broadband service.”).

¹¹⁷ See *Rural Broadband Access Loan and Loan Guarantee*, U.S. DEP’T OF AGRIC.: RURAL DEV., <https://www.rd.usda.gov/programs-services/rural-broadband-access-loan-and-loan-guarantee> (last visited July 30, 2020) (stating that “[t]he Rural Broadband Access Loan and Loan Guarantee Program (Broadband Program) furnishes loans and loan guarantees to provide funds for the costs of construction, improvement, or acquisition of facilities and equipment needed to provide service at the broadband lending speed in eligible rural areas.”).

¹¹⁸ See Larra Clark, *FCC Announces Connect America Fund*, District Dispatch (Oct. 31, 2011), <https://www.districtdispatch.org/2011/10/fcc-announces-connect-america-fund>.

¹¹⁹ See *In re Connect American Fund*, F.C.C. 11-161 (Nov. 18, 2011).

¹²⁰ See FED. COMM. COMM’N, DA 18-253, ONLINE AUCTION APPLICATION TUTORIAL AVAILABLE FOR THE CONNECT AMERICA FUND PHASE II AUCTION (AUCTION 903) (Mar. 15, 2018); see, e.g., *Auctions*, FED COMM. COMM’N, http://wireless.fcc.gov/auctions/default.htm?job=auctions_home (last visited July 30, 2020).

Broadband Loans and Loan Guarantee program, Telecommunications Infrastructure Loans and Loan Guarantees, and Community Connect Grants.¹²¹ Even “Smart Grid” financing programs enable the deployment of fiber assets that can in turn be leveraged for the delivery of broadband services.¹²² In the 2020 CARES Act, the FCC was provided \$3.2 billion for an Emergency Broadband Connectivity Fund, which funds connected devices and monthly discount off of standard broadband rates.¹²³ Additionally, the CARES Act funding has been used by various states to fund broadband buildouts.¹²⁴ The 2021 American Rescue Plan provides \$10 billion for state capital projects, which includes broadband buildout.¹²⁵ The proposed American Jobs Plan from the Biden administration has provided \$100 billion tagged for broadband buildout.¹²⁶ Finally, in the Fiscal Year 2021 United States Omnibus Budget bill, Congress and the President have allocated “\$730 million in the expansion of broadband service, including \$634 million for the ReConnect program, an increase of \$80 million over FY 2020.”¹²⁷

Beyond the actions of the federal government, some states implemented programs to encourage the deployment of high-speed broadband within their states. New York, for example, recently completed a \$500 million broadband auction that provided up to 80% of the funds required to deploy high-speed service.¹²⁸ This program has allowed New York to claim that 99% of its residential structures will have access to broadband service with speeds in excess of one hundred mbps for downloads and 99.9% will have access to broadband service with speeds in excess of twenty-five mbps for downloads. Pennsylvania, Ohio, Wisconsin, Georgia, and Missouri (to name a few) have also developed, or are in the process of developing, broadband grant or auction programs.

Below the state level, a number of cities have entered into public-private partnership with providers to roll out broadband services within their cities. City contributions have ranged from access to city infrastructure and simplified permitting to sharing in the cost of deployment.

¹²¹ *Telecom Programs*, U.S. DEP’T OF AGRIC.: RURAL DEV., <https://www.rd.usda.gov/programs-services/all-programs/telecom-programs> (last visited July 30, 2020).

¹²² See U.S. DEP’T OF AGRIC.: RURAL DEV., LEVERAGING SMART GRID INVESTMENTS FOR RURAL BROADBAND DEPLOYMENT, https://www.rd.usda.gov/files/UEP_RUSSmartGrid_BOC.pdf (last visited July 30, 2020).

¹²³ FEDERAL COMMUNICATIONS COMMISSION’S SPENDING PLAN FOR THE CARES ACT AND DIVISION N OF THE CONSOLIDATED APPROPRIATIONS ACT OF 2021, *cares-act-spending-plan-03252021.pdf* (fcc.gov) (last visited, June 25, 2021).

¹²⁴ See *States Tap Federal CARES Act to Expand Broadband*, PEW CHARITABLE TRUSTS, pewtrusts.org.

¹²⁵ Casey Lide, *Broadband Support for State and Local Govts Under the American Rescue Plan Act of 2021*, 191 Nat’l L. Rev. (2021), <https://www.natlawreview.com/article/broadband-support-opportunities-state-and-local-governments-under-american-rescue>.

¹²⁶ THE WHITE HOUSE, FACT SHEET: THE AMERICAN JOBS PLAN (2021), <https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/>.

¹²⁷ *FY 2021 Omnibus Appropriations Bill*, NAT’L CONF. ST. LEGS. (2021), <https://www.ncsl.org/ncsl-in-dc/publications-and-resources/fy-2021-omnibus-appropriations-bill.aspx>

¹²⁸ See, e.g., JEFFREY NORDHAUS, NEW NY BROADBAND PROGRAM, https://nysbroadband.ny.gov/sites/default/files/phase_2_bidders_ppt_0.pdf (last visited July 30, 2020).

XV. ECONOMIES OF SCOPE AND FRANCHISE MONOPOLY

Economies of scope is the multiproduct analog to economies of scale. It exists when the cost of jointly producing two or more products or services is less than the sum of the costs of producing them separately.¹²⁹ It arises when a company faces shared, joint, or common costs and then leverages those costs across multiple products. As with any cost advantage, it is generally good for the firm and its customers.

However, when the firm has significant market power in one market, it could be an issue when that firm expands into other markets. In particular, when a firm has a franchise-protected monopoly in one market, regulators and antitrust authorities have often constrained or precluded that firm's activities outside the original rate-regulated market (with the franchise-protected monopoly). Indeed, this was the rationale for the FCC's computer inquiries I, II, and III for thirty years.¹³⁰ The FCC wrestled with concerns of AT&T subsidizing competitive activities (particularly data-processing and other forms of non-communications computing) with revenues from its regulated services. Similarly, in the modified final judgement¹³¹ (and decisions by Judge Greene in its aftermath) involving the divestiture of AT&T and the Bell system, Regional Bell Companies were precluded from offering inter-LATA¹³² long-distance calling and from manufacturing telecommunications devices.

In each instance, it was AT&T/Bell System's significant market power in local distribution (and originally long distance) and the franchise-protected monopoly that caused regulators and antitrust authorities to preclude certain activities in other markets—even when economies of scope would likely have given AT&T/Bell System cost advantages in those new markets or industries.

The telecommunications landscape changed drastically in 1996. The first sentence of the Telecommunications Act of 1996 states that it is an act “[t]o promote competition” and, hence, significant changes were made in the industry to do so.¹³³ However, even in this new competitive environment, the Telecommunications Act still prohibits cross-subsidization of competitive services.¹³⁴

The telecommunications landscape continues to evolve as technology changes and merges, regulations are modified, and firms consolidate and enter the industry. Some of these cross-industry changes could reinvigorate old concerns about monopoly-competitive cross-subsidies. Today, these

¹²⁹ See, e.g., ALLEN ET AL., *supra* note 17, at 189–191.

¹³⁰ These inquiries began on November 9, 1966. See *In re Regulatory and Policy Problems Presented by the Interdependence of Computer and Communications Services and Facilities*, 28 F.C.C.2d 267 (1971).

¹³¹ See *United States v. W. Elec. Co., Inc.*, 569 F. Supp. 1057 (D.D.C. 1983).

¹³² Local Access Transport Areas were geographic regions established in the aftermath of AT&T divestiture.

¹³³ Telecommunications Act, Pub. L. No. 104-104, 110 Stat. 56 (1996). The term “competition” (or variations thereof) appears 68 times in the Act. For example, Sec. 101, Part II is entitled “Development of Competitive Markets.” Competition was accomplished in part via: 1) required physical interconnection; 2) forced unbundling of network components for sale to competitors; and 3) ability of competitors to purchase retail services of incumbents at a discount (to resell).

¹³⁴ See *id.* at § 241(k).

concerns come from electric companies using their electric networks as a basis for entry into the broadband marketplace. Electric power companies generally exhibit significant market power in electric power distribution networks.¹³⁵ It is not practical for other firms to attempt to enter these markets for electric power distribution, especially in rural areas that historically had received government subsidies. In the modern intersection of related industries, when contemplating competitive fairness (in the distribution of subsidies for broadband), is it possible for market-protected firms to enter the primary market of the firm seeking the subsidy? If the answer is “no,” the traditional competitive concerns of the FCC are still germane.

XVI. CONCLUSION

Like any investment project, a business deciding whether to deploy a network to a geographic area requires such a network to have a positive NPV (and a higher IRR than competing projects). Without an expectation of passing this financial hurdle, firms will be unable to undertake such projects. Critically, geographic networks (for example, broadband communications) exhibit economies of linear density. As illustrated above, linear density varies dramatically in the United States with vast regions of the country having very low density. Only three options (or some combination thereof) are possible in such low-density areas: (1) higher prices in low-density areas to reflect higher costs, (2) service not being offered in low-density areas since demand is insufficient to cover the higher costs, or (3) higher costs of providing service are at least partially subsidized. The public and the FCC, for broadband-related network services, are disinclined to accept higher prices in rural areas, which often are characterized by a population with lower incomes. The remaining choice is between subsidizing broadband, by some method, or leaving the most rural areas of the United States without broadband service.

The reality of the economics of linear density in rural areas exists in many geographic network industries: water distribution, sewer systems, natural gas distribution, roads, airlines, communications, and electric power. Due to the closeness of substitute services, water distribution, sewer systems, and natural gas distribution are virtually nonexistent in the most rural regions of the United States (and subsidies exist for their alternatives, such as wells and septic systems). However, for roads, electric power, and communications, no close substitutes exist. Therefore, these three network industries require subsidies for service to exist in the most rural regions of the United States.

In communications, historically, cross-subsidies (by a single firm, and later, between firms) were employed to achieve public policy objectives (such as universal service). However, such implicit subsidies relied upon rate-of-return regulation and significant market power (in the subsidy-providing segment) and are unsustainable in modern competitive communications markets. The form of the explicit subsidy could, at least in

¹³⁵ Electric power generation and high-voltage transmission do not necessarily exhibit these characteristics.

theory, vary. The explicit subsidy could take the form of access to low-cost infrastructure, low-interest loans, loan guarantees, up-front payments, ongoing payments, or other mechanisms.

If a potential service provider (for example, an electric power distribution company) claims to be able to offer broadband without a subsidy in such areas, it could likely only do so by leveraging economies of scope from subsidies to other services or the provision of other services with significant market power. Such leveraging has been a concern to regulators, including the FCC, for decades.