# BROADBAND FINANCIALS: A PRACTICAL PRIMER

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# The Purpose of this Paper

With the Infrastructure Investment and Jobs Act's Broadband Equity, Access, and Deployment (BEAD) Program the federal government has made a historic investment of $42.5 billion into broadband infrastructure. This is an unprecedented amount of funding to universalize broadband in the United States – but without proper guidance, it could easily be wasted.

State and local officials have a critical, frontline role in allocating these funds, but little experience executing broadband programs of this scale. Applicants for funding will range from the smallest community networks to the nation's largest incumbents, with proposals based on a wide variety of technologies, for-profit and non-profit business plans, and requested subsidy amounts. One of the most important jobs state and local officials have is to ensure that these projects will actually result in adequate, affordable, and sustainable broadband service.

This primer provides an introduction to broadband financials and some key questions broadband officials should consider incorporating into their evaluation process. The aim is to help readers manage broadband programs efficiently and effectively, aligned with two fundamental principles:

(1) Don't Overpay: Even with billions of dollars available, there is not enough money to achieve broadband policy goals if recipients are awarded much larger subsidies than they actually need. To make efficient use of public funds, broadband officials must consider not just build costs but also revenues, operating expenses, and the availability of private capital.

(2) Get What You Pay For: Investments in broadband should deliver lasting infrastructure. Federal policy envisions a wide range of players participating in broadband, including municipal networks, community institutions, rural cooperatives and, of course, communications companies. Any of these can successfully deliver broadband projects but all, whether for profit or nonprofit, need to have a viable financial plan.

# Contents

# 1. Overview

**This primer provides an introduction to the financial aspects of broadband projects for anyone involved in designing subsidy-award programs, reviewing applications, or making funding decisions. It explains financial terminology, discusses the typical business drivers of a broadband project, and shows how these drivers can be captured in a relatively simple quantitative model to provide insight into a proposed project's financial viability and funding needs.**

At this unique moment, in which a large amount of new government funding is available to achieve universal deployment – as well as other aims regarding affordability, adoption, usage, and competition – considering the financial aspects of broadband service will be essential, not only for achieving policy goals within available budgets but also to ensure that the broadband projects funded are sustainable for many years into the future. As such, the issues covered in this paper are relevant at every step of the subsidy-allocation process, from high-level program design to detailed due diligence of a particular project seeking public support, regardless of provider type or market environment.

1.1 **This paper is "policy agnostic" in that it does not advocate for, or against, any particular position, but rather provides a quantitative tool to assess the subsidy implications of different broadband-policy choices and make objective comparisons across potential projects.** Within a given budget, many different approaches to advancing the nation's broadband goals can be successful, but whatever choices are made – for example regarding preferred provider types, public/private ownership models, technologies deployed, service obligations, and communities prioritized – at some point in the process it will have to be determined if a request, e.g., for a $50m project subsidy is too high (because $10m would have been sufficient to meet actual project needs) or too low (because, even with a $50m award, the project is likely to fail). Ultimately, preferred policy goals – whatever they are – will not be achieved if the actual financial performance of broadband projects differs greatly from the expectations used to determine subsidies, and so a quantitative financial assessment must be an important part of any successful funding-allocation process.

1.2 **As broadband projects generally generate substantial revenues from monthly subscription fees that offset construction, operating, and financing costs, the relevant question for determining appropriate subsidy amounts is, "How big is the gap that needs to be filled between expected costs and revenues?" not "How much will it cost to build this broadband network?"** That is, unlike many other types of publicly-funded infrastructure projects and government grant processes, broadband awards should not just be based on defining and reimbursing "eligible costs." Indeed, focusing only on costs will lead to enormous waste in the form of excessive payments to broadband providers, exhausting subsidy funds before policy goals are achieved. Avoiding this by answering the "gap" question requires a quantitative assessment – even if only at a high level – of the project's overall financial model.

**1.3 Broadband financial models are not complicated, but their structure and terminology may be unfamiliar, and appropriate assumptions – particularly for unserved areas that often have project-specific challenges and metrics that are very far from national averages – may vary widely, and so be difficult to validate.**

This primer aims to help by:

- In Section 2, explaining the four typical stages of a broadband project that drive its financials. [Readers familiar with broadband-deployment projects who want to focus on the corresponding financial models may want to skip from Section 2.1 to Section 3]
- In Section 3, discussing how the four stages can be translated into a simple, quantitative model that can be used to make an initial assessment of a proposed project's business drivers, operating assumptions, and funding needs.
- In Appendix A, providing a checklist of financially-oriented questions that might be used as a template for gathering qualitative information from applicants as part of project due diligence.
- In Appendix B, providing a working financial model (in the form of an Excel spreadsheet) that demonstrates the concepts described in Sections 2 and 3, and might be used as a template for gathering quantitative information from applicants in a standardized form to test the assumptions behind funding requests and benchmark financial metrics, allowing objective comparisons across projects and the identification of outliers.

**1.4 Although each broadband project is unique and every unserved geography across the nation has different characteristics, all projects have the same basic financial drivers discussed below.** That is, by varying its inputs, a financial model like the one outlined in this paper can describe any type of broadband project – incumbent or new entrant, publicly or privately owned, wireline or wireless, large or small – and quantify how different operating and policy choices translate into higher or lower subsidy needs, allowing limited budgets to be best allocated to achieve broadband deployment, adoption, and usage goals. This primer is intended to provide enough familiarity with financial modeling to incorporate such an objective financial assessment into policy choices and subsidy-award decisions. However, it is not intended as a guide to generally accepted accounting principles (GAAP) related to broadband projects or as a complete due-diligence roadmap, which would also include issues such as assessing management capabilities and technical risk.

## 2. Financial drivers: Four stages of a typical broadband project

**In a particular geography, a broadband project can be thought of as having four, roughly sequential stages, namely: planning and financing, initial build, subscriber ramp up, and – finally – “steady state” operations (see Figure 1). This section discusses each in turn, highlighting its relevance for the project’s overall financials.**

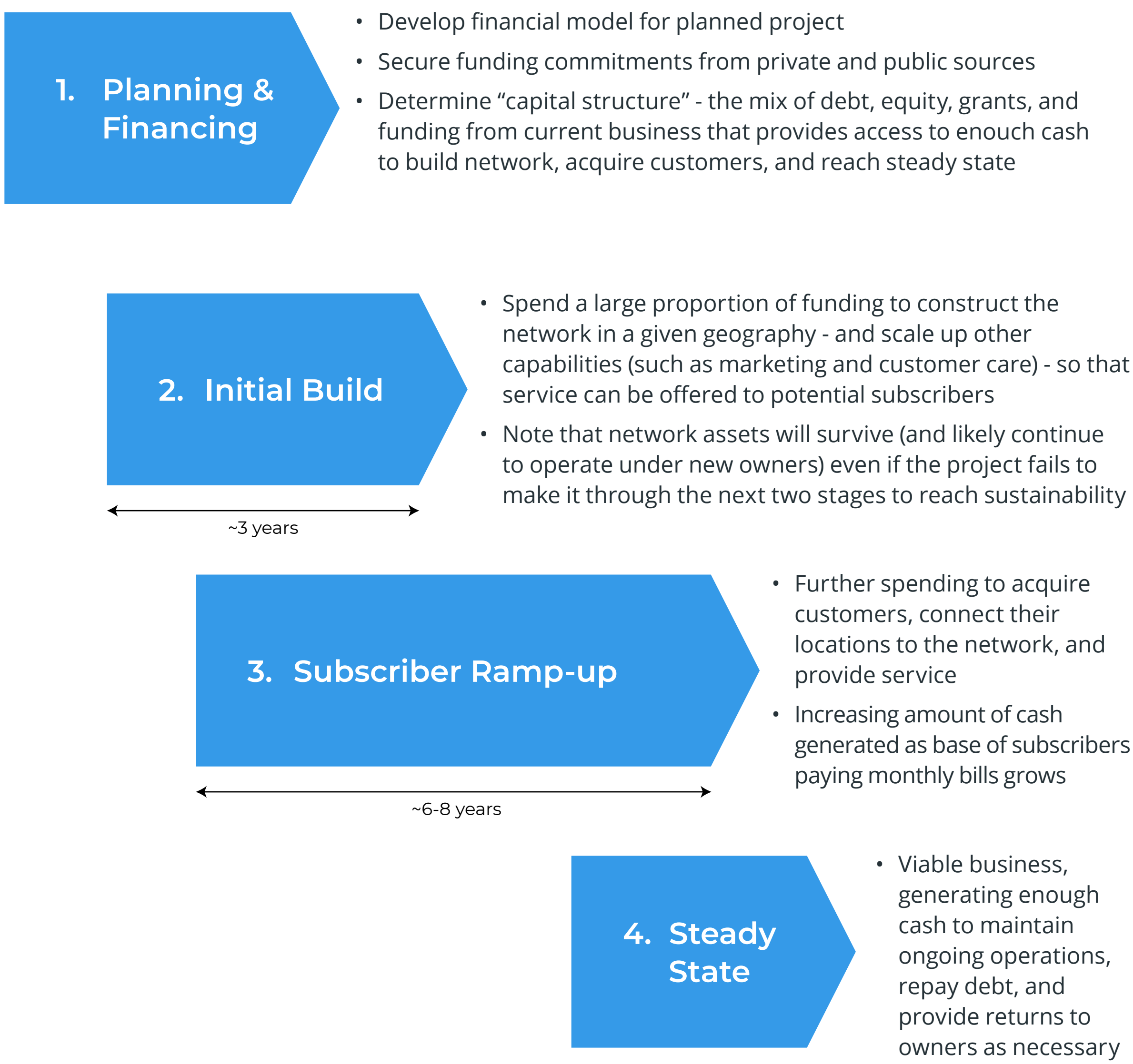


*Figure 1: Four stages underlying the financials of a broadband project*

**2.1 Stage 1: Planning and Financing. The planning stage should produce a financial model similar to that discussed in Section 3 of this paper, providing an estimate of the project's steady-state profitability and hence anticipated funding needs based on forecasts of cost-to-serve and revenue from the potential customers offered service.** Before making subsidy requests, applicants may already have done some outreach to validate assumptions (e.g., about costs and potential customers' needs and interest in broadband), and used the model as a basis for discussions with investors, perhaps even securing financing commitments (possibly contingent on receiving government support).[1]

**2.1.1 Broadly, there are three potential types of external funding, one or more of which policymakers might choose to provide from broadband-subsidy budgets:**

- ***Debt:*** Loans or bonds with a variety of terms and conditions, including a committed schedule for repayment at an interest rate that reflects the lender's assessment of risk. For example, USDA's ReConnect program offers eligible borrowers loans at 2% annual interest rate, repayable over the economic life of the project's facilities plus three years,[2] while a variety of private lenders (e.g., banks, infrastructure funds, and other "credit investors") provide finance at rates and terms dependent on project-specific due diligence.

- ***Equity:*** Sale of an ownership stake in the entity responsible for the project, so that the public or private equity holder is entitled to a share of future profits from operating or selling the business. In general, private-sector equity purchasers expect higher returns than debt holders as – in the absence of repayment commitments or other claims – they are taking a greater risk that returns will not materialize. For the government, taking a minority or majority equity stake is a form of public/private partnership.

- ***Grants:*** Notwithstanding the potential financial implications of grant obligations (such as the cost of commitments regarding build-out locations and timing, quality-of-service, or pricing), grants are "free money" for the project's owners, and therefore give the biggest boost to financial viability. Correspondingly, for the government, grants are the biggest drain on the subsidy budget, providing neither the prospect of repayment (like offering loans) nor potential upside from a project's future profitability (like taking an equity stake in return for public funding). To date, the FCC's grant-based Universal Service Fund (USF) has been the largest source of public broadband funding, most recently via the Connect America Fund (CAF) and Rural Digital Opportunity Fund (RDOF).

[1] The information requests in Appendices A and B should, therefore, not be burdensome, as credible applicants will have to provide similar information to private funders (or, for incumbents, use similar information to make internal investment decisions). The availability of tens of billions of dollars of government funding for deployment is increasing investor interest in public and private broadband projects, and hence the potential availability of private capital as a multiplier for subsidies.

[2] See "Rural E-Connectivity Program Application Guide for Fiscal Year 2022" (Rural Utilities Service Telecommunications Program, November 21st 2021), p.9. As well as the repayment schedule, ReConnect loans have other terms and conditions aimed at achieving rural-broadband policy priorities.

**2.1.2 The "capital structure" of the proposed project is the mix of debt, equity, and grants that make up the project's total funding.**[3] For the project's owners, the goal is generally to minimize capital requirements and obtain the cheapest possible financing, i.e., the lowest "weighted average cost of capital (WACC)." That is, of the total funding, as large a proportion of grants as possible, loans with the best terms (e.g., lowest interest rates, longest repayment periods, and least collateral), and as much cash in return for the smallest equity stake. Note that "private investment" is not synonymous with private ownership – for example muni networks often access private capital markets by issuing bonds and localities can sell ownership (equity) stakes in broadband projects to private investors while maintaining operational control over drivers of policy priorities, such as pricing and communities served.

- For example, consider a broadband project in which the owners (public and/or private equity holders) are willing to invest $10m and can raise $10m in private debt with principal repayment due in 10 years at 5% annual interest. This means the project has $20m of cash available to start the project (i.e., for initial build and customer acquisition, discussed in Sections 2.2 and 2.3), a $500,000 (=5%*$10m) fixed annual interest cost, payable regardless of the project's actual operating performance, a $10m principal repayment due in ten years, and equity holders with the expectation that the success of the project will, over time, provide a higher return on their initial $10m investment than other currently available opportunities.[4]

- *If the project's full financial model, accounting for all expected revenues and costs, suggests the capital structure described above is sufficient, then no subsidy is needed. Indeed, any public financing will just displace private capital, resulting in a windfall for the project's owners (who have the incentive to obtain the largest subsidy possible, regardless of actual need).* On the other hand, if the model does suggest a funding gap, then a subsidy award might fill it, for example using one or more of: (a) a grant to fill the gap directly; (b) a loan with a lower interest rate/better terms than the existing facility; (c) the purchase of an equity stake (though, as equity returns from the project are distributed across all owners, joint public/private ownership reduces private returns).[5]

- *The decision to offer grants, loans, and/or equity purchases to subsidize broadband projects is a policy choice, as each mechanism has different pros and cons.* Given the size of funding budgets and the availability of private capital, however, it may be beneficial to adopt an "investment catalyst" approach, considering how public funding can best be used to attract as much private investment as possible, rather than assuming projects require large grants, with relatively

[3] For accounting purposes, grant funding is generally reported as revenue that is entirely profit. In terms of understanding a project's fundamental financials, however, it is more useful to model grants as a potential source of capital so that operating-performance metrics are not distorted and funders can consider providing debt and/or buying equity as alternative subsidy approaches.

[4] Similarly, an incumbent extending its network to new areas might finance this project, in whole or part, with cash generated by current businesses if that appears to be a better use than other available opportunities.

[5] More complex structures – such as other forms of credit enhancement (e.g., loan guarantees or loan loss reserves), preferred stock, or equity warrants – could be considered, but are beyond the scope of this primer.

small matching requirements aimed at screening out speculative applications (e.g., 25% for both ReConnect grants and the Broadband Access, Equity, and Deployment program under the 2021 Infrastructure Investment and Jobs Act).

2.1.3 **Due to the availability of private financing for both public and private initiatives, as well as revenues from future broadband customers, for most reasonable projects, the funding gap that needs to be filled will be significantly lower than the capital expense ("capex") required to build the broadband network.** As such – regardless of the subsidy-award mechanisms used and resulting ownership structure (private, public, or a public/private partnership) – familiarity with the project's overall capital structure and financial model is necessary to determine the appropriate level and form of public support. Simply providing "cost-based" grants will prove to be exceptionally wasteful and likely drain the subsidy budget before desired broadband policy goals have been achieved.

- *As broadband networks are expensive to build but generally quite profitable to operate, most reasonable projects should have the option to raise significant funding from private sources.* That is, the lack of current infrastructure in a particular area does not mean that private funding is completely unavailable, but rather that the expected returns to private capital are inadequate compared to other investment opportunities. The government's task is therefore not necessarily to fund the entire cost of the project – particularly if it is privately owned[6] – but rather to boost expected returns sufficiently to attract multiplicative private funding, without which subsidy budgets will likely be exhausted long before policy goals are achieved. The only way to accomplish this task is with a well-structured competitive award process supported by the kind of quantitative financial modeling discussed in this paper.

- For example, if two projects each require a $100m investment to get started, with Project A expected to return $10m and Project B $20m, an investor with $100m, given the choice, would obviously invest in Project B. But this does not mean that Project A requires a $100m grant to make it equally attractive. Rather a $10m grant would boost Project A's return (= ($10+$10)/$100 = 20%) to the same level as Project B's (= $20/$100 = 20%). A $50m "equity" purchase (with no expectation of return) would have the same effect (increasing the return for the remaining $50m investment opportunity to $10/($100-$50) = 20%), as would, for example, a $80m loan with a 7.5% return expectation (leaving a $20m investment opportunity with a ($10-7.5%*$80)/$20 = 20% return).[7]

[6] To use an infrastructure analogy, this would be like the government paying for the entire construction cost of a toll road and then, on completion, gifting it to a private owner to keep all the tolls. As noted above, obtaining private debt and/or equity investment does not mean that the project has to be privately owned.

[7] Reflecting Section 2.1.1, the grant provides the biggest boost to Project A's financials, and therefore requires a smaller amount ($10m) of subsidy – and catalyzes a larger relative private investment – than the equity investment ($50m) or the loan ($80m). On the other hand, the grant is money given away, while the equity investment and the loan provide an opportunity for cash to be returned and recycled for future projects. Note that mistakenly concluding that Project A requires an $80m grant, assuming a 25% matching contribution (= 25%*$80m = $20m) to cover the full $100m investment required, would increase returns to ($10+$80)/$100 = 90%, while a $100m grant to cover the full investment would lead to a ($10+$100)/$100 = 110% return.

- As a practical illustration, in the FCC's RDOF Phase I auction, 41% of winning bids for ten years of support were for less than $1,000 of annual subsidy, and 11% for less than $100 of annual subsidy. Even assuming some of the bids were irrationally low, and so will not in fact lead to broadband service being provided, such small amounts illustrate the catalytic effect on private investment of relatively small grants, as the awards are unlikely to represent the full cost of meeting the winners' build-out and other commitments, particularly considering that the average winning bid covered ~98 unserved locations and 99.7% of locations covered by winning bids have been promised at least 100Mbps downstream service (and 85% promised Gigabit service).

- Similarly, one of the largest winners in the RDOF auction (Charter Communications), will receive a subsidy of ~$1.2b over ten years to offer service to just over 1m unserved locations. The company later stated that it "expects to invest approximately $5 billion to support its build out initiative - offset by $1.2 billion in support won from the RDOF auction,"[8] matching the public subsidy by more than 3-to-1, a not atypical ratio. This significant private investment would have been displaced if the public funding had been based on covering the full $5b cost.

### 2.1.4 With regard to financing, funders may want to ask applicants questions such as:

- *What is the initial funding need and expectation for private vs. public financing? What is the status of discussions with, and commitments from, private investors? Why does the applicant need any public financing?* The applicant should be able to explain why the subsidy support is needed and how it is being used to attract (rather than displace) private capital, creating a multiplier for the public's investment. As this is an iterative process – private capital being attracted by the prospect of public funding and public funding filling the gap left by private capital – it should of course not be the case that only projects with fully committed financing should be eligible for awards.

- *What is the target capital structure? (i.e., what are the expectations for private funding in the form of equity vs. debt and public funding in the form of equity vs. debt vs. grants?) Who are the expected equity holders and what returns do they expect on their investment? What are the expected terms of private debt (interest rate, covenants, repayment schedule)?* Public funding can be used for a combination of grants, loans (at terms more attractive than those available in private markets), and/or equity (i.e., public ownership of a minority or majority of the project). As noted above, grants will likely exhaust the subsidy budget more quickly than either loans (where the expectation is that the funding will be repaid over time) or acquisition of equity stakes (where the funder receives some of the upside if the project is successful), although a well-structured grant program – i.e., one designed to provide private capital with reasonable (but not excessive) returns and awards based on an assessment

[8] See "Charter Communications Launches New Multiyear, Multibillion-Dollar Initiative To Expand Broadband Availability To Over 1 Million New Customer Locations" (Charter Communications Investors News Release, February 1, 2021). Note that this >300% ratio based on the availability of private capital is not atypical.

of the funding gap, not just build costs – may offer the benefits of operational simplicity and hence the quickest path to deployment.

- *What happens to the project's assets (in particular the network) in the event of financial failure?* In the event that – despite best intentions – the project is not successful, the debt holders typically take control of the assets while the equity holders' ownership stakes are rendered worthless.[9]

- *For subsidized projects, the funder should clarify what might trigger a loan default and what claims the government has in the event of a restructuring.* For example, USDA ReConnect loans require that "the government must be provided an exclusive first lien on all grant-funded assets during the service obligation of the grant"[10] (i.e., the government is first in line to take ownership of the assets if the project fails). New York State's broadband program also required a lien in the event of a future default, so that if a funding recipient abandoned a project during construction, the state could recover the partly-built assets and find an alternate provider to complete the project, rather than writing it off entirely.

[Note: Readers familiar with broadband-deployment projects who want to focus on financial modeling may want to go directly from here to Section 3.]

**2.2 Stage 2: Initial build. Once funding is in place, the second stage is building enough of the network infrastructure so that service can be both offered and actually provided to new customers in a reasonable time frame.**[11] By definition, this initial investment largely takes place before revenue starts to be generated, and so draws on the funding secured in Stage 1. For new operators, this will also be the time to begin building other capabilities necessary to run the business as it grows, such as sales and marketing, billing, and customer care.

**2.2.1 Initial network capex can be thought of as having a "fixed" component, which needs to be put in place to offer service, and a "success based" component only incurred when a customer is acquired.** The latter consists mainly of costs associated with the last-mile connection to the subscriber's location and customer-premise equipment (CPE), while the former consists of the all the remaining broadband infrastructure, such as the middle-mile and core networks and IT systems.

**2.2.2 The relative amounts of fixed- and success-based capex will be project dependent, driven by factors including:**

- *The broadband technology being used:* e.g., for a wireless network, fixed costs may include expenses related to towers, poles, radios, and spectrum licenses to offer service, while success-based costs include CPE, but there is

[9] In this case, the government's equity effectively becomes a grant, and so the public is no worse off than if a similarly-sized grant had been awarded initially, pre-emptively ruling out any chance of a return.

[10] See "Rural E-Connectivity Program Application Guide for Fiscal Year 2022" (Rural Utilities Service Telecommunications Program, November 21st 2021), p.8.

[11] Funders need to have a clear and enforceable definition of what it means to "offer service" so providers know how much of the network needs to be built in this stage versus being deferred until subscribers sign up. For RDOF, the FCC uses the definition that "a support recipient is deemed to be commercially offering voice and/or broadband service to a location if it provides service to the location or could provide it within 10 business days upon request." See, e.g., "Rural Digital Opportunity Fund Support Authorized For 2,008 Winning Bids" (FCC, December 14th 2021), fn. 6.

no additional cost to connect a location to the network if it is in the wireless coverage area. In contrast, a wireline network will have both the fixed costs of passing a location (e.g., running fiber down a street with multiple houses) and also significant success-based costs to connect a new location, which requires the additional construction of an underground or overhead last-mile "drop" between the customer's premise and the network (e.g. from the customer's house to the fiber running down the street).[12]

- *If the operator is a new entrant or an incumbent:* As the latter may obtain scale benefits in purchasing and already have in place many fixed-cost items required to offer service, e.g., IT systems and elements of the network, such as tower leases and fiber routes. On the other hand, a new entrant may be able to use more efficient non-legacy technologies and business practices, while also bringing the structural benefits of competition.

- *The geography being addressed:* Network costs are highly dependent on the specific geography being addressed and so need to be examined in detail, e.g., to account for local differences in aerial vs. underground fiber, pole and tower costs, middle-mile availability, and labor rates. All else equal, fixed costs likely increase for more remote markets (due to higher middle-mile expenses) and success-based costs increase for lower density markets (due to higher last-mile expenses). Further, as the cost per unserved location can vary by orders of magnitude, the overall scale of the project and particular locations addressed can dramatically affect the project's financial model.

### 2.2.3 With regard to the initial build, funders may want to ask applicants questions such as:

- *What geographic markets will the build cover? What is the geographic sequencing and timing of the initial network build?* The location and timing of service launch is not only critical for meeting broadband-policy goals but also drives a project's financials. For example, build costs will vary greatly with the locations and density of addressable customers, while the financial profile of a project will look quite different if all locations are offered service at the end of the first year rather than in phases over several years (see Section 2.3.2 below). Further, understanding the project's overall financials requires a model that includes all the locations addressed by the project, each of which may incur costs and generate revenues, whether currently served or unserved.[13]

- *What are the expected fixed costs vs. the success-based (per subscriber) costs corresponding to the build plan?* As build costs vary significantly with geography, ensuring the expected timing and amount of capex aligns with the build plan will clarify the financial implications of the proposed sequencing. For example, it may make sense to build to more profitable locations first so that the cash generated can cross subsidize the later build to less profitable areas.

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[12] On the other hand, if it becomes necessary to increase broadband performance in the future, fiber-based wireline networks are unlikely to require significant additional capex (i.e., they are closer to "future proofed"), whereas wireless networks may need costly new spectrum, radios, towers, poles, and/or CPE.

[13] For a discussion of the mixing of served and unserved locations in the geographies generally addressed by broadband projects see Jon Wilkins, "Seizing the Moment: Scaling Up State Broadband Strategies" (Quadra Partners, with support from Schmidt Futures, July 2021), pp.24-28.

- *What are the biggest risks to the proposed build that could materially impact the project's financials?* For example, a delay in construction means interest and other costs are incurred for a longer period without revenue generation. Such delays may be caused by unanticipated events, e.g., construction-cost overruns, supply-chain constraints on labor or materials, permitting problems, or the actual performance of novel wireless technologies differing from theoretical specifications.

- *Are there non-financial actions the government could take to materially reduce the cost, time required, and/or risk of the initial build?* Other policies may be complementary to providing subsidies, further improving the business case for a proposed broadband project. For example, agencies may consider allowing access to public infrastructure, simplifying permitting processes, improving information about the locations of fiber and rights-of-way, and ensuring state/local coordination to the extent appropriate to reflect community interests.

**2.3 Stage 3: Subscriber ramp-up. Once broadband service can be offered to a critical mass of initial locations, the project operator will start to sign up customers, spending additional cash on sales, marketing, and other operating expenses ("opex"), but also generating increasing revenue as the customer base grows.**

**2.3.1 After service is launched in a particular geographic market, the ramp up of subscribers will generally follow an "S curve," with the rate of growth and eventual market share depending on factors such as the competitive environment, marketing success, price, and quality of service.** For example, as shown in Figure 2, a provider with an attractive offering in an unserved area with minimal competition might reach a high market share relatively quickly (e.g., ~80% in 3-5 years); conversely, in an already served area, where the new entrant has to overcome customer switching inertia and competitive responses, it may take much longer to reach a lower equilibrium share (e.g., ~40% in 6-10 years). In reality, most projects will cover a mix of served and unserved locations, and so the penetration curve will likely be somewhere in between these two bounds.

**2.3.2 Note also that total capex per subscriber (as opposed to per location offered service) falls as the base grows due to fixed costs being allocated over more customers.** E.g., if a wireline project has an $18m fixed cost to offer service to a market with 6,000 addressable locations, the financials of an unserved area, where penetration may reach 80% – and so the allocation of fixed capex per subscriber would be $3,750 (=$18m/(80%*6,000)) – will be better than in an already served area where penetration may only reach 40% (i.e., a $7,500 =$18m/(40%*6,000) allocation of fixed capex per subscriber).

**2.3.3 As discussed in Section 2.2, it is necessary to be clear about when broadband service will actually be offered in each geography, as this not only affects the ultimate policy goal of getting people connected, but also has a material impact on the project's financials.** For example, as shown in Figure 3, by the end of Year 2, a project with all locations launched at the same time might have about twice as many subscribers (and hence generate cash more quickly) compared to one launched in three phases over two years, even though the subscriber base reaches the same steady-state level.

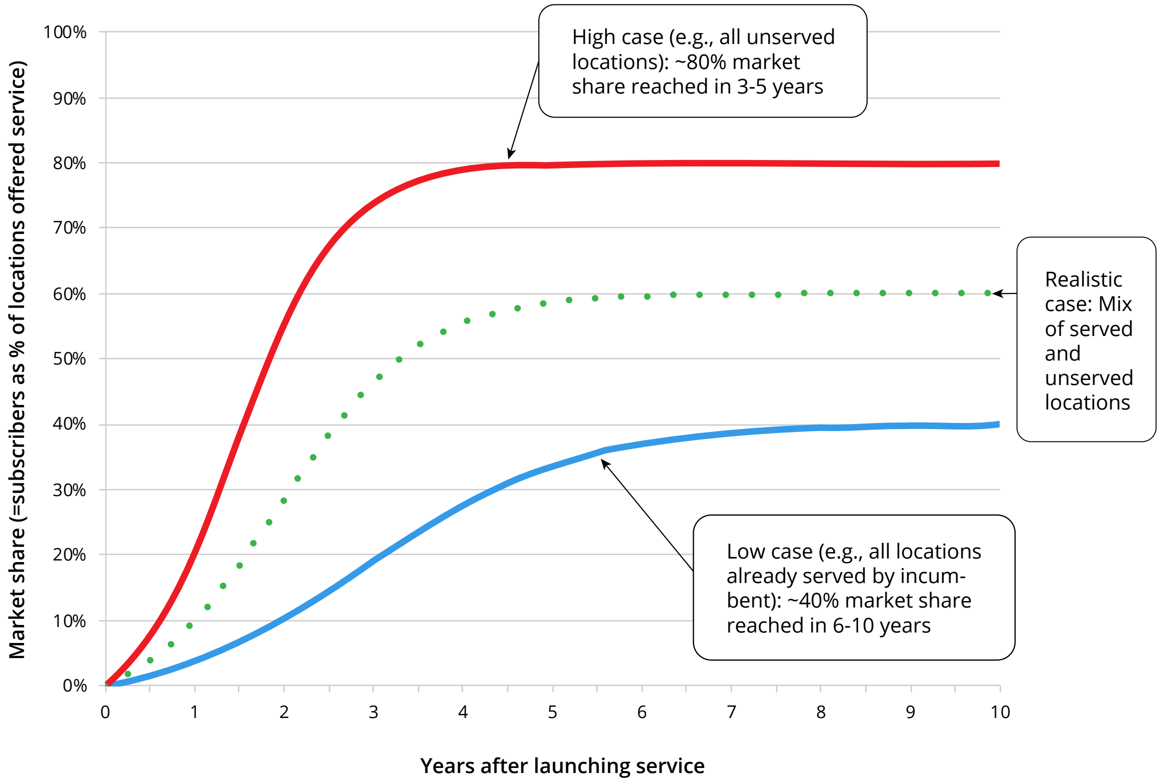


***Figure 2: Examples of subscriber ramp-up in a given geography***

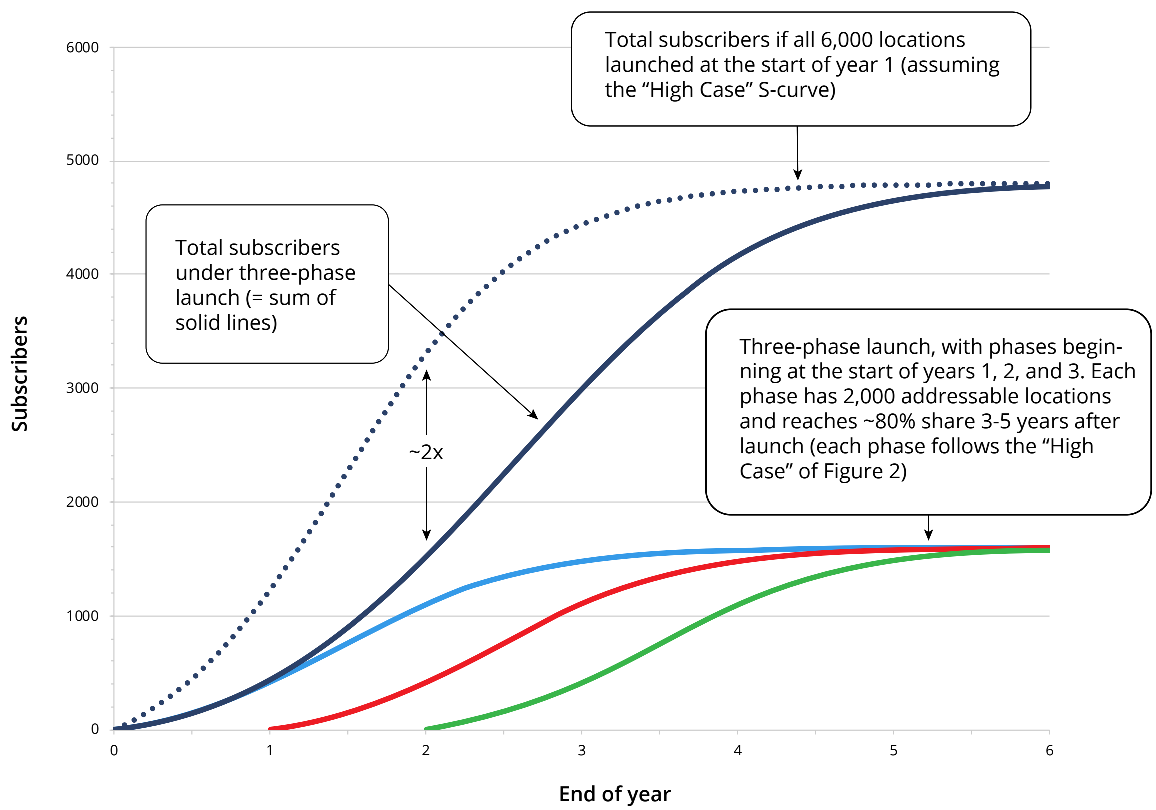


***Figure 3: Effect of service-launch timing on subscriber trajectory***
*(which will in turn materially affect project financials)*

### 2.3.4 The ramp-up phase drives three aspects of the project's financials, namely:

- *Revenue from the subscriber base:* As customers are added, the project begins to generate increasing amounts of cash from monthly fees, driven by the number of users and the average revenue per user (ARPU), the latter varying based on pricing and the offerings different subscribers choose to take (e.g., more expensive higher-speed broadband vs. lower priced service, more expensive business and anchor institution connectivity vs. residential broadband, uptake of additional services such as telephony). Note that a quantitative financial model is the only way to assess the implications for subsidy needs of pricing choices/obligations, such as a low-cost service option offered to a particular customer segment (e.g., households enrolled in the federal Affordable Connectivity Program) or to all potential subscribers.

- *Expenses for customer acquisition and provisioning:* Though this stage is the first in which the project begins to generate cash, it also entails continuing expenses to sign up subscribers and provide them with service. This "cost per gross addition (CPGA)"[14] includes both operating expenses, such as marketing and installation, and the success-based capital expenses discussed in Section 2.2.1.

- *Other operating expenses as the project's operations scale up:* These expenses are generally separated into two categories, namely the "cost of goods sold (COGS)," defined as opex directly attributable to providing service (such as tower and real-estate rental, payments to other telecom operators for middle-mile and backhaul, and utility charges), and other "selling, general, and administrative (SG&A)" expenses (such as employees' wages and benefits, customer service and care costs, insurance, and office rent).

**2.3.5 Note the discussion in this paper assumes a "vertically integrated operator" that both owns the network and offers retail service, like almost all U.S. fixed broadband providers.** For an "open access" project – in which the subsidized provider builds and operates the network but does not retail the broadband service – ARPU will be lower, reflecting wholesale prices (e.g., $30 per month instead of the $65 that the customer pays, with the difference being retained by the retailer), as will operating expenses, in the absence of functions like sales, marketing, and customer care. Whether a lower revenue/lower expense open-access model requires more-or-less public funding than a vertically-integrated one is project specific,[15] but the question can be readily explored using the same model discussed in Section 3 below.

[14] The common broadband metric of "gross adds" is distinguished from "net adds," the difference between the two being the number of subscribers lost. For example, a project starting the year with 5,000 broadband subscribers that, during the year, adds 2,000 subs and loses 750, to end with 6,250 subs would have 2,000 gross adds and 1,250 net adds. Gross adds drive acquisition expenses, while net adds drive the size of the subscriber base and hence revenue and direct costs.

[15] In particular, a key assumption is whether the single open-access network serves more customers in a given area than would the alternative vertically-integrated operator(s), allowing the fixed costs to be spread over a larger base, as discussed in Section 2.3.2. That is, ignoring competitive implications and all else equal, a single open-access network supporting retailers serving 80% of locations in a given geography is likely to have a better financial model than two vertically-integrated operators that both build out the same area, each reaching 40% share (as all three operators have roughly the same fixed costs but the open-access network has twice as many subscribers, albeit it at lower ARPU). On the other hand, a single vertically-integrated operator with 80% share is likely to have better economics than an open-access network supporting retailers accounting for 80%, as both operators have roughly the same fixed costs, but the former retains the retail profit forgone by the latter. As the reality for a given project will likely be somewhere between these two extremes, which model is superior – and therefore needs less subsidy – requires examination of the project-specific financial model.

### 2.3.6 With regard to subscriber ramp up, funders may want to ask applicants questions such as:

- *How will service launch be sequenced across the areas covered by the project?* For example, in the situation shown in Figure 3, will all 6,000 locations be offered service at the same time (the dashed line), or will the locations covered be launched in phases, e.g., 2,000 locations at a time over two years (the solid lines)? The answer to this question should be consistent with the build sequencing discussed in Section 2.2.3, recognizing that there will be a weeks-to-months time lag between a location being "passed" by the network and actually being "open for sale."

- *What is the expected market share over time in each geography from the time of launch?* The expectation should be something like the S-curves in Figure 2, with the rate of growth and ultimate share consistent with operational capabilities (e.g., in marketing and installation) and current/future competition in each geography. Separating the market-share curves for markets launched at different times will provide greater insight into the expected trajectory of subscriber growth and hence financial performance.

- *What are the expected ARPU and CPGA, and how are they expected to evolve over time?* ARPU and the opex portion of CPGA will vary with the demand and competition profiles of the covered areas and should be consistent with pricing and market-share expectations (the capex portion of CPGA will depend on the technology and business model being employed, as discussed in Section 2.2.2).

- *What are the main categories of, and expenditures on, COGS and SG&A, and how are they expected to evolve over time?* COGS will vary based on the network architecture (e.g., where and how much network capacity is being purchased from third parties, tower costs for wireless networks), while SG&A should reflect business operations that are reasonable and consistent with the size of the customer base, e.g., in terms of the number of employees needed in different business functions and compensation levels. As COGS and SG&A are driven by dozens of line items, benchmarking across projects to spot outliers will be an efficient way to perform an initial test of reasonableness.

**2.4 Stage 4: Steady state. Once market share approaches the top of the S-curve, the project will be operationally successful, providing broadband service to a large proportion of formerly unserved locations and generating revenue in excess of cash costs for ongoing operating expenses and network maintenance.** At this stage, therefore, the main financial considerations are (a) whether the project is sufficiently profitable to meet the financial commitments agreed to in Stage 1 (e.g., debt repayment), and (b) the risk of competitive and/or regulatory changes disrupting the equilibrium of the business (e.g., causing a loss of significant market share or the need for material capex to upgrade network performance).

**2.4.1 At steady-state market share, the two main operating drivers of the project's financial performance are ARPU (discussed in Section 2.3.4) and churn, defined as the proportion of the subscriber base that disconnects every month.**

- ***ARPU:*** As costs are largely fixed by the time a project reaches steady state, changes in revenue have a disproportionate effect on profits as price changes drop straight to the bottom line (this is sometimes referred to as "operating leverage"). For example, a project with 4,800 steady state subscribers, $60 monthly ARPU, and $100,000 monthly costs generates (4,800 x $60)-$100,000 = $188,000 of monthly profit. All else equal, raising ARPU by 5.0% to $63, results in profit of (4,800 x $63)-$100,000 = $202,400, a 7.7% increase.

- ***Churn:*** For the same reason, increases in subscriber losses can disproportionately decrease profitability. Continuing the example above, a (typical) 1% monthly churn – e.g., disconnects due to an inability to pay bills, moves, and/or subscribers switching to other providers – reduces the subscriber base from 4,800 to 4,800-(1% x 4,800) = 4,752 over the course of a month, and hence profitability (all else equal) from $188,000 to (4,752 x $60)-$100,000 = $185,120, a 1.5% decrease.

**2.4.2 The ongoing business of sustainable projects in steady state will be quite profitable, typically having 1.5 to 3 times as much cash coming in from monthly bill payments as going out to pay operating expenses.**[16] If they run into trouble, therefore, it is generally not due to the business being unprofitable, but rather because the profit is insufficient to repay the debt (principal and interest) incurred to finance the project (Stage 1). This may be due to having had overly optimistic assumptions about the steady state operating metrics (such as market share, ARPU, and churn) or unanticipated disruptions to the business from competitive entry or regulation. The quantitative model discussed in Section 3 can be used to test the robustness of a proposed broadband project's financial viability to these assumptions.

- Note that, because a project's operations are likely to be profitable, even in the event of financial distress, the network assets will have value as part of an ongoing business and customers' broadband service will likely remain uninterrupted while the capital structure is reconfigured. This has been the case, for example, with public wireline ISPs that have had to undergo financial restructuring due to an inability to meet their debt commitments, such as Frontier (2020), Windstream (2019), and Charter (2009).

[16] If this is not the case – and certainly if cash from bill payments is less than operating and maintenance expenses in steady state – the project will likely require ongoing subsidies to continue operating. Although this may be acceptable if expected by the funder in advance, rather than an unwelcome surprise several years into the project (i.e., to achieve other policy priorities, the funder was comfortable with a financial model showing losses in perpetuity), as it should only be the case for sub-scale projects and/or those addressing only the highest cost-to-serve areas (e.g., the most costly ~1% of unserved locations), as an alternative, the geographic scope of the project, or the network technology used, could be modified to increase operating profitability.

### 2.4.3 With regard to the anticipated steady-state operations, funders may want to ask applicants questions such as:

- *How sensitive is the project's financial viability to operating assumptions, such as market share, ARPU, and churn?* Projects may be more or less risky based on the target capital structure and the nature of broadband supply and demand in the geographies being addressed. For example, all else equal, a higher debt-to-equity ratio is likely to make a project more sensitive to the business underperforming because of the larger fixed debt repayments that are due regardless of operational success.

- *What are the biggest medium-to-long term competitive risks in the geographies addressed by the project?* The technological and economic environment of broadband deployment is continuing to evolve, particularly with respect to new satellite (e.g., low-earth-orbit operators, such as SpaceX's Starlink and Amazon's Kuiper) and wireless (e.g., national mobile players' 5G) offerings, as well as the increased availability of private capital for broadband projects, enabling network upgrades and overbuilds. As a result, even currently unserved areas may be served by multiple providers in the future, resulting in deviations from market share, ARPU, and churn assumptions.

- *How much capex would be required to significantly upgrade broadband service if that becomes necessary in the future?* Even if the chance of needing future network upgrades (e.g., due to competition, consumer demand, or regulation) seems low at present, as such assumptions have often proven wrong, it is worth understanding if the financial model has enough room to accommodate upgrade costs, particularly for "non-future-proof" networks, where the incremental upgrade cost could be material.

In terms of financial viability, the initial financing (Section 2.1, cash in) needs to be sufficient to get through the initial network build (Section 2.2, cash out) and subscriber ramp up (Section 2.3, cash out at first, but then increasing amounts of cash in from the monthly bills paid by the growing customer base), and reach steady state (Section 2.4, enough cash in from customers to pay for ongoing operations, repay initial financing and generate sufficient ongoing profit for owners). To assess how receiving some form of subsidy might affect a project's viability requires translating the four stages described above into a quantitative model that can provide financial projections, as well as sensitivities to assumptions about drivers such as time-to-market, capex, subscribers, and ARPU. This translation process is discussed in the next section.

# 3. From the four stages to a financial model

[Note: Readers may find it helpful to have the Excel version of Figure 4 (which can be downloaded from Appendix B) on hand while reading this section.]

**Figure 4 shows the structure of a high-level model that can be used to assess the financials of any broadband project, regardless of provider type, customers served, market environment, and other factors that affect the model's inputs. This section aims to help readers gain familiarity with such models, which should facilitate conversations with applicants about funding needs and enable decisions about the appropriate size and structure of subsidy awards. The section starts with an overview of the model (3.1) and then explains how its three main modules – corresponding to operations (3.2), capex (3.3), and financing (3.4) – are organized and relate to the four project stages discussed in Section 2.**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Illustrative financial model for a proposed broadband project** | | | | | | | | | | | | |
| | | Inputs in blue Outputs in black | **End of year** | | | | | | | | | |
| Line | *Formula* | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | **Operations** | | | | | | | | | | |
| 1 | *a* | Addressable market (locations offered service) | 2,000 | 4,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 |
| 2 | *b* | Market share (%) | 18% | 35% | 48% | 68% | 77% | 79% | 80% | 80% | 80% | 80% |
| 3 | *c=a*b* | Subscribers (locations taking service) | 360 | 1,412 | 2,876 | 4,089 | 4,632 | 4,767 | 4,794 | 4,800 | 4,800 | 4,800 |
| 4 | *d=change in c* | Net adds (locations) | 360 | 1,052 | 1,464 | 1,213 | 543 | 135 | 27 | 6 | - | - |
| 5 | *e* | Monthly churn (%) | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% |
| 6 | *f=1-(1-e)^12* | Implied annual churn (%) | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% | 11.4% |
| 7 | *g=d+f*prior year c* | Gross adds (locations) | 360 | 1,093 | 1,624 | 1,540 | 1,008 | 661 | 569 | 551 | 545 | 545 |
| 8 | *h* | Monthly ARPU ($) | $ 65 | $ 65 | $ 65 | $ 65 | $ 65 | $ 70 | $ 70 | $ 75 | $ 75 | $ 75 |
| 9 | *i=c*(h*12)* | Total revenue ($) | $ 280,800 | $ 1,101,360 | $ 2,243,280 | $ 3,189,420 | $ 3,612,960 | $ 4,004,280 | $ 4,026,960 | $ 4,320,000 | $ 4,320,000 | $ 4,320,000 |
| 10 | *j* | Cost of Goods Sold (COGS) ($) | $ 105,000 | $ 285,000 | $ 520,000 | $ 720,000 | $ 765,000 | $ 780,000 | $ 780,000 | $ 790,000 | $ 790,000 | $ 795,000 |
| 11 | *k=1-j/i* | Gross margin | 63% | 74% | 77% | 77% | 79% | 81% | 81% | 82% | 82% | 82% |
| 12 | *l* | Cost per gross add (opex) ($) | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 | $ 500 |
| 13 | *m=g*l* | Subscriber acquisition costs ($) | $ 180,000 | $ 546,451 | $ 812,212 | $ 769,879 | $ 503,786 | $ 330,633 | $ 284,302 | $ 275,335 | $ 272,676 | $ 272,676 |
| 14 | *n* | Other Selling, General & Admin. (SG&A) costs ($) | $ 240,000 | $ 280,000 | $ 330,000 | $ 440,000 | $ 540,000 | $ 635,000 | $ 660,000 | $ 680,000 | $ 680,000 | $ 680,000 |
| 15 | *o=j+m+n* | Total operating expenses ($) | $ 525,000 | $ 1,111,451 | $ 1,662,212 | $ 1,929,879 | $ 1,808,786 | $ 1,745,633 | $ 1,724,302 | $ 1,745,335 | $ 1,742,676 | $ 1,747,676 |
| 16 | *A=i-o* | Earnings before interest, taxes, depreciation, and amortization (EBITDA) [≈cash from operations] ($) | $ (244,200) | $ (10,091) | $ 581,068 | $ 1,259,541 | $ 1,804,174 | $ 2,258,647 | $ 2,302,658 | $ 2,574,665 | $ 2,577,324 | $ 2,572,324 |
| 17 | *p=A/i* | EBITDA margin (%) | -87% | -1% | 26% | 39% | 50% | 56% | 57% | 60% | 60% | 60% |
| | | **Capex (investment)** | | | | | | | | | | |
| 18 | *q* | Cost per gross add (capex only) ($) | $ 1,000 | $ 1,000 | $ 1,000 | $ 750 | $ 750 | $ 750 | $ 500 | $ 500 | $ 500 | $ 500 |
| 19 | *r=g*q* | Capex (success based) ($) | $ 360,000 | $ 1,092,901 | $ 1,624,425 | $ 1,154,818 | $ 755,679 | $ 495,949 | $ 284,302 | $ 275,335 | $ 272,676 | $ 272,676 |
| 20 | *s* | Capex (fixed) ($) | $ 8,000,000 | $ 6,000,000 | $ 4,000,000 | $ 360,000 | $ 360,000 | $ 360,000 | $ 360,000 | $ 360,000 | $ 360,000 | $ 360,000 |
| 21 | *t=total s to date* | Cumulative fixed capex ($) | $ 8,000,000 | $ 14,000,000 | $ 18,000,000 | $ 18,360,000 | $ 18,720,000 | $ 19,080,000 | $ 19,440,000 | $ 19,800,000 | $ 20,160,000 | $ 20,520,000 |
| 22 | *u=t/a* | Cumulative fixed capex per addressable location ($/location) | $ 4,000 | $ 3,500 | $ 3,000 | $ 3,060 | $ 3,120 | $ 3,180 | $ 3,240 | $ 3,300 | $ 3,360 | $ 3,420 |
| 23 | *B=r+s* | Total capex ($) | $ 8,360,000 | $ 7,092,901 | $ 5,624,425 | $ 1,514,818 | $ 1,115,679 | $ 855,949 | $ 644,302 | $ 635,335 | $ 632,676 | $ 632,676 |
| 24 | *v=total B to date* | Cumulative total capex ($) | $ 8,360,000 | $ 15,452,901 | $ 21,077,326 | $ 22,592,144 | $ 23,707,823 | $ 24,563,772 | $ 25,208,074 | $ 25,843,409 | $ 26,476,085 | $ 27,108,762 |
| 25 | *w=v/c* | Cumulative total capex per subscriber ($/sub) | $ 23,222 | $ 10,944 | $ 7,329 | $ 5,525 | $ 5,118 | $ 5,153 | $ 5,258 | $ 5,384 | $ 5,516 | $ 5,648 |
| 26 | *C* | Other material operations or investment cash uses ($) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 27 | *D=A-B-C* | EBITDA-capex-other cash uses [≈"Free cash flow"] ($) | $ (8,604,200) | $ (7,102,992) | $ (5,043,357) | $ (255,276) | $ 688,495 | $ 1,402,698 | $ 1,658,357 | $ 1,939,329 | $ 1,944,647 | $ 1,939,647 |
| | | **Financing** | | | | | | | | | | |
| 28 | *x* | Cash in from grants ($) | $ 2,500,000 | $ 2,500,000 | $ 2,500,000 | $ 2,500,000 | $ - | $ - | $ - | $ - | $ - | $ - |
| 29 | *y* | Cash in from loans ($) | $ 10,000,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 30 | *z* | Cash out for loan interest and repayment ($) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (10,500,000) |
| 31 | *aa=y+z* | Net cash in from loans ($) | $ 9,500,000 | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (500,000) | $ (10,500,000) |
| 32 | *bb* | Cash in from equity ($) | $ 10,000,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 33 | *cc* | Cash out to equity (dividends) ($) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (1,000,000) | $ (1,000,000) | $ (1,000,000) |
| 34 | *dd=bb+cc* | Net cash in from equity ($) | $ 10,000,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ (1,000,000) | $ (1,000,000) | $ (1,000,000) |
| 35 | *E=x+aa+dd* | Total cash in from financing ($) | $ 22,000,000 | $ 2,000,000 | $ 2,000,000 | $ 2,000,000 | $ (500,000) | $ (500,000) | $ (500,000) | $ (1,500,000) | $ (1,500,000) | $ (11,500,000) |
| | | **Total** | | | | | | | | | | |
| 36 | *F=E+D=A-B-C+D* | Total change in cash ($) | $ 13,395,800 | $ (5,102,992) | $ (3,043,357) | $ 1,744,724 | $ 188,495 | $ 902,698 | $ 1,158,357 | $ 439,329 | $ 444,647 | $ (9,560,353) |
| 37 | *G=F+prior year G* | Total cash balance ($) | $ 13,395,800 | $ 8,292,808 | $ 5,249,451 | $ 6,994,175 | $ 7,182,669 | $ 8,085,368 | $ 9,243,724 | $ 9,683,053 | $ 10,127,701 | $ 567,348 |

***Figure 4: Illustrative financial model***

*(High-Res PDF and Excel file can be downloaded from Appendix B)*

3.1 **Model overview: The basic approach to building a financial model focuses on the project's sources and uses of cash as, regardless of how promising a project is in principle, in practice it will not be able to proceed if initial funding cannot be raised, and will run into trouble (including possible bankruptcy) if the bills cannot be paid at any time after launch.** The model groups the project's main sources and uses of cash (shown in Figure 5) into three modules describing operations (lines 1-17 in Figure 4, corresponding to Stages 3 and 4 above), capital expenditures (lines 18-25, corresponding to Stages 2, 3, and to a lesser extent 4), and financing (lines 28-35, corresponding to Stage 1). Line 36 sums the net change in cash during each year from the three categories and line 37 reports the resulting end-of-year cash balance.

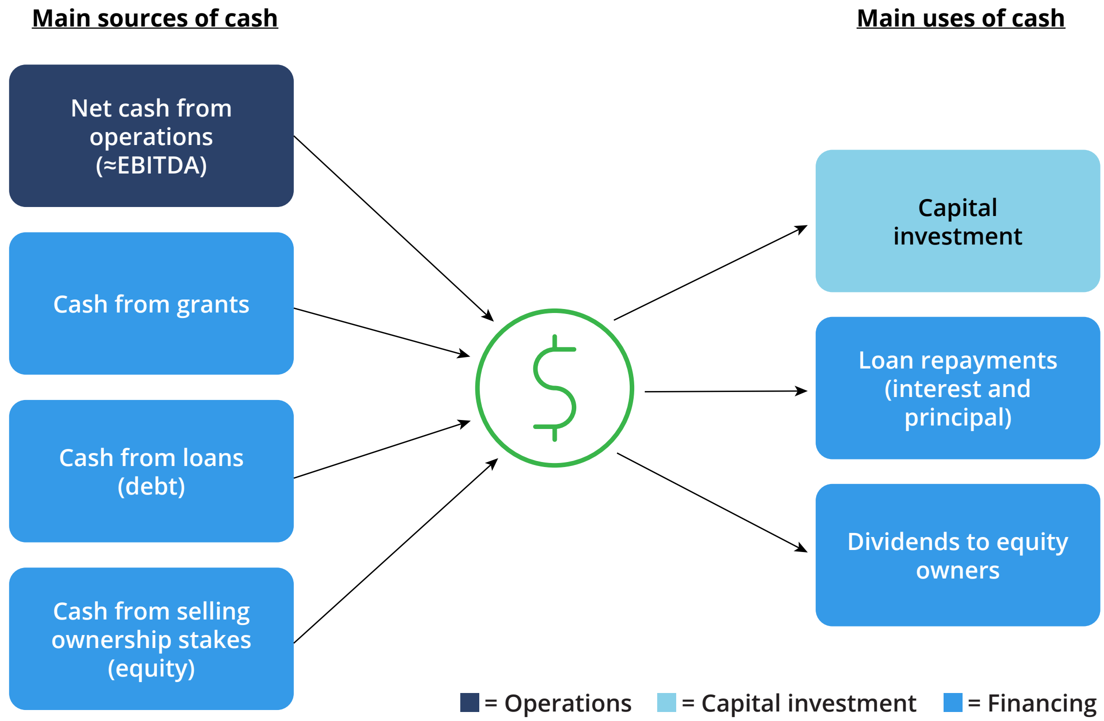


***Figure 5: Sources and uses of cash***

3.1.1 **Though it may be puzzling that reading the model from top-to-bottom means considering the four stages in reverse order, this is the sequence generally used for financial reporting (a typical example of which is shown in Figure 6).** This ordering also corresponds to the logic of "free cash flow (FCF)" (line 27), a common financial metric reflecting the cash generated by the project that will be available to the debt and equity holders after capex and other material operating cash needs (line 26) are taken into account.[17]

[17] Free cash flow is the foundation for "discounted cash flow" (DCF) valuation, which assesses how much an enterprise is worth based on its ability to generate cash for its owners after taking into account all other financial obligations.

| | Three months ended | |
|---|---|---|
| | March 31, 2021 | March 31, 2020 |
| **OPERATING ACTIVITIES** | | |
| Net cash provided by operating activities | 1,525 | 1,299 |
| **INVESTING ACTIVITIES** | | |
| Capital expenditures | (716) | (974) |
| Proceeds from sale of property, plant and equipment and other assets | 35 | 35 |
| Other, net | 6 | — |
| Net cash used in investing activities | (675) | (939) |
| **FINANCING ACTIVITIES** | | |
| Net proceeds from issuance of long-term debt | 891 | 1,237 |
| Payments of long-term debt | (1,176) | (2,488) |
| Net (payments of) proceeds from revolving line of credit | (150) | 1,125 |
| Dividends paid | (294) | (291) |
| Other, net | (45) | (69) |
| Net cash used in financing activities | (774) | (486) |
| Net increase (decrease) in cash, cash equivalents and restricted cash | 76 | (126) |
| Cash, cash equivalents and restricted cash at beginning of period | 427 | 1,717 |
| Cash, cash equivalents and restricted cash at end of period | $ 503 | 1,591 |

***Figure 6: Example public report of sources and uses of cash***
*(Lumen Technologies, Inc., based on Lumen Q1 2021 Results News Release)*

**3.1.2 Note that Figure 5 and the model reflect the practical "fungibility of cash." That is, all sources of cash (from operations and financing) are combined in a single funding pool that is drained by the uses of cash (for capex, operating expenses, and financial obligations).** As such, it may be counterproductive to place stringent financial constraints on the uses of subsidy awards beyond those necessary to prevent fraud and waste.[18] Rather, to ensure the responsible use of public funds, policymakers should be comfortable with the project's overall business model, including the amounts proposed for construction costs, management salaries, and other expenses – as well as the reasonableness of expected returns for public and private investors given the risk they are taking.

- For example, consider a project that in a given year receives $1m in grants, makes $1m in operating profit, and spends $1m on capex, $0.5m on interest payments, and $0.5m on dividends. There is little point in stipulating that the grant money must go to capex and the operating profit to interest and dividend payments rather than vice versa as cash is cash regardless of its source. Indeed, it may well be the case that the project was able to raise private capital to multiply the grant because the private funders' risk was reduced by having guaranteed cash from the grant available if the operational cash failed to materialize according to plan.

[18] Note the distinction between "financial constraints" (specifying that cash from public sources can be used for some purposes, e.g., capex, but not others, e.g., loan repayments) and "performance obligations" (imposing conditions on the project's operations that must be met in return for receiving subsidies, e.g., timing milestones to start offering broadband service of a specified quality, ceilings on service prices, etc.), which are necessary for achieving policy goals but may have financial implications that should be incorporated into the model during the planning stage.

- Rather than trying to direct which sources of cash get used for what purposes, it would be better for policymakers to ensure that the interest and dividend payments are not excessive, the operating profit does not hide excessive expenses, the capex is not inflated by unreasonable construction costs, and so forth. This can only be done by examining the project's overall financial model before deciding on subsidy awards.

3.1.3 **The model provides a ten-year forecast, reflecting the time required for the example project to reach steady state, as well as the term of the debt.** Given the long lifespan of broadband infrastructure, and often financing, it is unlikely that shorter forecast periods will give sufficient insight into a project's overall financials, though longer forecasts may be useful, notwithstanding the increasing uncertainty regarding assumptions as the forecast period is extended.

3.2 **Operations (lines 1-17): The most common financial metric for quantifying the operating performance of broadband businesses (as seen, for example in Figure 7) is "earnings before interest, taxes, depreciation, and amortization (EBITDA)," which approximates the cash generated from running the business, that is revenue less opex.**[19,20] Consistent with the model's three-module structure, opex excludes both capex (covered in Section 3.3) and financing costs, such as interest expenses (covered in Section 3.4).

| Year ended December 31 (in millions) | 2020 | 2019 | 2018 | % Change 2019 to 2020 | % Change 2018 to 2019 |
|---|---|---|---|---|---|
| **Revenue** | | | | | |
| Residential: | | | | | |
| High-speed internet | $ **20,599** | $ 18,752 | $ 17,144 | **9.9 %** | 9.4 % |
| Video | **21,937** | 22,270 | 22,455 | **(1.5)** | (0.8) |
| Voice | **3,532** | 3,879 | 3,960 | **(8.9)** | (2.1) |
| Wireless | **1,574** | 1,167 | 890 | **34.9** | 31.2 |
| Business services | **8,191** | 7,795 | 7,129 | **5.1** | 9.3 |
| Advertising | **2,594** | 2,465 | 2,795 | **5.2** | (11.8) |
| Other | **1,624** | 1,754 | 1,660 | **(7.5)** | 5.7 |
| **Total revenue** | **60,051** | 58,082 | 56,033 | **3.4** | 3.7 |
| **Operating costs and expenses** | | | | | |
| Programming | **13,498** | 13,389 | 13,249 | **0.8** | 1.1 |
| Technical and product support | **8,022** | 7,973 | 7,569 | **0.6** | 5.3 |
| Customer service | **2,432** | 2,494 | 2,536 | **(2.5)** | (1.6) |
| Advertising, marketing and promotion | **3,759** | 4,014 | 4,002 | **(6.3)** | 0.3 |
| Franchise and other regulatory fees | **1,625** | 1,582 | 1,578 | **2.7** | 0.2 |
| Other | **5,445** | 5,364 | 5,418 | **1.5** | (1.0) |
| Total operating costs and expenses | **34,781** | 34,816 | 34,352 | **(0.1)** | 1.4 |
| **Adjusted EBITDA** | $ **25,270** | $ 23,266 | $ 21,681 | **8.6 %** | 7.3 % |

Comcast 2020 Annual Report on Form 10-K

***Figure 7: Example public report of operating financials***
*(Comcast's Cable Communications business)*

[19] From an accounting perspective EBITDA is an income-statement metric and, as such, reflects when items are recognized, which may differ from when cash actually flows in or out, e.g., because customer charges may be recognized as revenue before payments are received, operating costs recognized as expenses before bills are paid, and so forth. For the high-level, long-term financial assessment of broadband projects discussed in this paper, the difference between EBITDA and operating cash is unlikely to be material, however line 26 of the spreadsheet provides a place to include items reconciling the two if necessary.

[20] EBITDA is often used as the basis for: (a) assessing how much an enterprise is worth using an "EBITDA multiple," in which value is regarded as being proportional to actual or forecast EBITDA (for illustration, at the time of writing (1/22), large, public ISPs trade at enterprise values of ~8x times estimated 2021 EBITDA); (b) assessing indebtedness using "debt-to-EBITDA" ratios (e.g., at the time of writing, large, public ISPs have net debt of ~3.5x estimated 2021 EBITDA); (c) reporting "Adjusted EBITDA" (as in Figure 7), in which items are added or subtracted from EBITDA in an attempt to better reflect underlying operating performance for forecasting (e.g., a one-time operating expense might be excluded).

The business drivers of EBITDA are shown schematically in Figure 8, corresponding in the model to the size of the subscriber base at the end of the year (line 3) and the total customer additions (gross adds) during the year (line 7), which respectively drive the total annual revenue (line 9) and subscriber acquisition opex (line 13). EBITDA (line 16) is given by revenue less total opex (line 15), the latter being the sum of COGS (line 10), opex for customer acquisition (line 13), and other SG&A expenses (line 14). Gross margin (line 11) and EBITDA margin (line 17), are common metrics of operating profitability, useful for benchmarking across proposed projects, that reflect different measures of profit as a percentage of revenue.

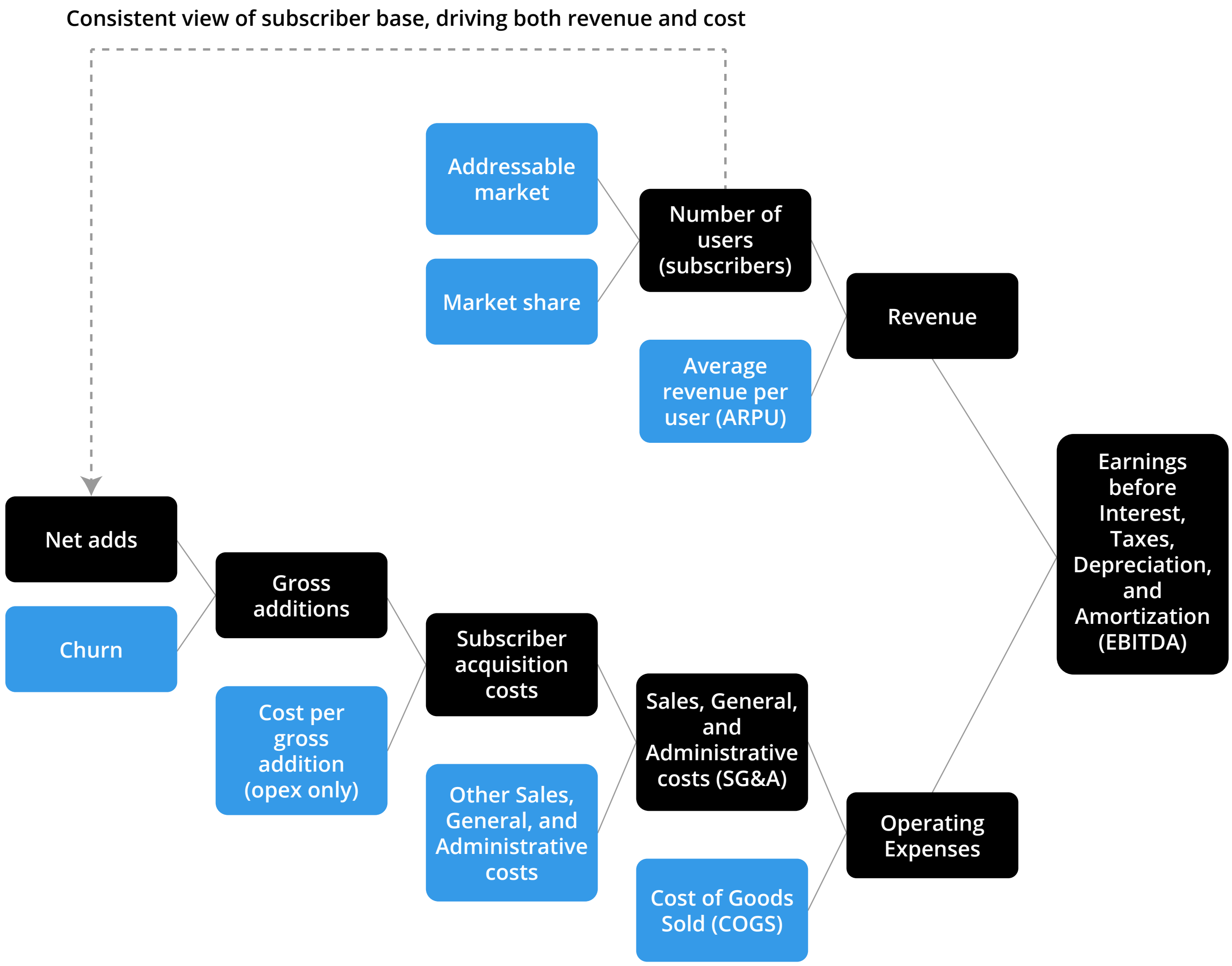


***Figure 8: Business drivers of EBITDA*** *(≈cash from operations)*
*(Blue boxes correspond to model inputs in Figure 4 and black boxes to outputs)*

Note that in the example shown in Figure 4:

- The addressable market (line 1) corresponds to the three-phase build to a currently unserved area (as discussed in Section 2.3.2), the number of subscribers (line 3) following the solid-black-line S-curve in Figure 3 that reaches high penetration relatively quickly.

- Monthly churn is modeled at 1% (line 5), equivalent to losing ~11% of the base during the year (line 6). Due to moves and non-payment, monthly broadband churn is rarely much lower than 1% even in non-competitive markets, and may be significantly higher if customers are able to switch between two or more providers.

- Monthly ARPU (line 8) is assumed to increase by $10 over the ten-year forecast period, reflecting a combination of price increases and subscribers paying more for better (e.g., higher speed) service.

- Opex per gross add (line 12) is assumed to be constant at $500 per subscriber, while COGS (line 10) and other SG&A (line 14) reflect typical trajectories with expenses growing over time as the subscriber base grows, but not in direct proportion to the customer base or gross adds.[21]

- Steady-state EBITDA margins are typically in the 45-70% range, primarily driven by the market environment, which in turn influences steady-state market share, churn, and ARPU. Though this means that the operating business is quite profitable, this cash has to fund both capex and financing obligations, and so does not represent the full picture of a broadband project's financial performance.

3.3 **Capital expenditures (lines 18-25): Total capex during the year (line 23) is the sum of "fixed" capex (line 20) – investments independent of the size of the subscriber base, such as the Stage 2 initial network build and ongoing maintenance capex – and "success based" capex (line 19), investments only incurred when a customer is acquired**, derived by multiplying the number of gross adds during each period (line 7) by the average capex per gross add (line 18). Lines 22 and 25 provide two common metrics, useful for benchmarking across proposed projects, namely the average capex spent per location to offer service and the average total capex per subscriber. Note that in the example shown in Figure 4:

- The capex per gross add (line 18) falls over time, reflecting a network in which the connection to the location needs to be built the first time a customer signs up, but then remains in place, so that, over time, more new customers are in locations that have already been connected (e.g., a new resident moving into a house that had been connected for the prior occupant who terminated service on moving).

- The fixed capex for the initial network build (line 20) is mostly incurred in the first three years and then reduces to a relatively low ongoing amount for maintenance (2% per year of the $18m initial build expense) reflecting a "future proofed" network that does not require material upgrade capex after initial construction.

- As discussed in Section 2.3.2, while the fixed capex per home passed (row 22) – i.e., the investment required to offer broadband service to the addressable locations – is fairly constant, the total capex per subscriber (row 25) falls rapidly over time as market share grows and fixed capex is allocated over a larger subscriber base. Also, over the ten-year period modeled, total success-based capex (the difference between rows 24 and 21) accounts for ~25% of total capex ($27.1-$20.5 = $6.6m out of

[21] A rough comparison to an open access model (as discussed in Section 2.3.5), can be made by setting the opex per gross add to zero (assuming these costs are borne by the retailer), adjusting the revenue down to reflect the lower wholesale rate, and changing the market share and financing assumptions (if any differences can be justified).

$27.1m by year 10), a material amount that would be overlooked by focusing only on the metric of cost per location.

**3.4 Financing (lines 28-35): The net cash flow from (or to) the funders of the project during the year (line 35) is the sum of grant payments received (line 28), the net inflow from borrowing (line 31) – i.e., loans drawn down (line 29) less interest and principal repaid (line 30) – and the net result of transactions with the project's owners (line 34), that is sales of equity (line 32) less dividends paid out (line 33).**

Note that in the example shown in Figure 4:

- The project's capital structure consists of a $10m grant, paid out in $2.5m installments over the first four years of the project, a $10m loan repaid in Year 10 along with 5% ($500,000) annual interest, and an initial $10m investment from the project's public or private equity owners, who – in Year 8, when the project has reached steady state – begin to receive $1m per year of annual dividends.

- At the end of the forecast period, as the debt has been repaid, the equity holders (as the owners of the project) are also entitled to the end of Year 10 cash balance ($0.6m, line 37) and the annual free cash flow beyond the forecast period (~$2m per year if the steady state continues, line 27).[22]

- If the debt and equity were both raised from private sources, grants would fund 33% of the total capital needed. In other words, the "matching capital" ratio is 2:1, or 200% ($20m of private capital and $10m of grants), significantly higher than matching conditions that are often required.

**3.5 Total cash balance (lines 36-37): The cash balance at the end of a given year (line 37) is that at the end of the prior year adjusted by total change in cash during the year (line 36), which in turn is the net cash in from operations (line 16) and financing (line 35), less total capex (line 23) and other material cash uses (line 26), or equivalently the free cash flow (line 27) plus net cash from financing (line 35).** A forecast that the future cash balance might turn negative (e.g., when the model is updated with actual operating results post-launch) will trigger a significant change in plans, such as attempts to raise more public/private funding, cuts to operating expenses, capex, and/or dividends, or renegotiations of loan repayment schedules.[23] Note that in the example shown in Figure 4:

- The cash balance follows the typical trajectory for a successful broadband project, namely a sizeable starting balance that is used to fund the initial network build and customer ramp up, and then grows as the operating business generates increasing amount of cash that is used to repay and provide returns to the initial financers.

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[22] If the owners were to sell all or part of the project, the transaction price would be based on this stream of future cash and/or the annual steady-state EBITDA. E.g., at a "10xEBITDA" multiple, the entire ownership stake in the project would be sold for ~$26m (= 10 x $2.6m, the Year 10 (steady state) EBITDA in line 16). If the sale were to happen in Year 10, then the equity holders' total return on their $10m Year 1 investment would be ~$30m ($3m in dividends received in Years 7-10, plus $0.6m Year 10 cash balance, plus $26m sale price). For private investors, this expected return would influence their initial decision to invest in this project compared to other potential opportunities. For government equity holders, the return could be used to replenish the pool of broadband-subsidy funds.

[23] In reality, debt generally has conditions ("covenants") that are more constraining than the project running out of cash, e.g., triggering default if metrics such as the ratio of outstanding debt to EBITDA, interest to EBITDA, or debt to free cash flow exceed levels regarded by the lender as indicating that future repayment is unlikely. A request for covenant details is included on the checklist in Appendix A.

- As the project has reached a profitable steady state by the end of the forecast period, even if the cash balance in Year 10 was insufficient to repay the full $10m principal, e.g., due to a lower level of initial grant support, in reality the owners would likely be able to refinance the debt and continue operations. This would become apparent by extending the model's forecast period beyond ten years.

- Illustrating the point made at the start of this paper regarding the need to have visibility into the overall financial model, rather than just providing grants based on the cost of the network build, the $10m total grant award (line 28) is just half the ~$20m total fixed capex (line 21) required to offer service to the 6,000 unserved locations addressed by the project, but is nonetheless sufficient to ensure that the cash balance (line 37) remains positive over the entire forecast period under the proposed returns to the debt (line 31) and equity (line 34) holders.

- As financial performance will ultimately determine the long-term success of broadband policies, even a simple quantitative model, as described in this paper, can be useful for exploring the implications of different operating assumptions and policy choices. This can be done by examining the effect on the cash balance (line 37) of changes to the model inputs (shown in blue), for example reflecting different scenarios for market share, ARPU (e.g., due to pricing choices or obligations), build timing, open access requirements, subsidy types and amounts, public ownership, and private investment expectations. A standardized model allows an objective comparison of projects under consideration, helping to ensure that award choices are justifiable, meet budget constraints, and result in the achievement of broadband policy goals for deployment, adoption, and usage.

# Appendix A. Financial assessment: Information checklist (fillable)

Based on the discussion in Section 2, the checklist below provides an overview of the kinds of (mostly qualitative) information that might be requested from funding applicants to help assess a proposed project's financial plan.

| | Example questions |
|---|---|
| 1. Planning and financing | ☐ What is the initial funding need and expectation for private vs. public financing?<br>☐ What is the status of discussions with, and commitments from, private investors?<br>☐ Why does the applicant need any public financing?<br>☐ What is the target capital structure? (i.e., what are the expectations for private funding in the form of equity vs. debt and public funding in the form of equity vs. debt vs. grants?)<br>☐ Who are the expected equity holders and what returns do they expect on their initial investment?<br>☐ What are the expected terms of private debt (interest rate, covenants, repayment schedule)?<br>☐ What happens to the project's assets (in particular the network) in the event of financial failure? |
| 2. Initial build | ☐ What geographical markets will the build cover?<br>☐ What is the planned geographical sequencing and timing of the initial network build?<br>☐ What are the expected fixed vs. success-based (per subscriber) costs corresponding to the build plan?<br>☐ What are the biggest risks to the proposed build that could materially impact the project's financials?<br>☐ Are there non-financial actions the government could take to materially reduce the cost, time required, and/or risk of the initial build? |
| 3. Subscriber ramp-up | ☐ How will service launch be sequenced across the areas covered by the project?<br>☐ What is the expected market share over time in each geography from the time of launch?<br>☐ What are the expected average revenue per user (ARPU) and cost per gross add (CPGA)? How are they expected to evolve over time?<br>☐ What is the basis for expectations about market share, ARPU, and CPGA over time?<br>☐ What are the main categories of, and expenditures on, COGS and SG&A, and how are they expected to evolve over time? |
| 4. Steady state | ☐ How sensitive is the project's financial viability to operating assumptions, such as market share, ARPU, and churn?<br>☐ What are the biggest medium-to-long term competitive risks in the geographies addressed by the project?<br>☐ How much capex would be required to significantly upgrade broadband service if that becomes necessary in the future? |

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# Appendix B. Financial model: Excel spreadsheet

Clicking on the link below provides the Excel version of the illustrative financial model discussed in Section 3 (and shown in Figure 4). Along with the more qualitative information listed in Appendix A, funders may want to use a spreadsheet akin to this one to structure a quantitative data request to applicants (e.g., asking for it to be filled out for a given project with base, best, and worst-case scenarios to illustrate sensitivities). This should provide insight into a proposed project's fundamental financials as an initial, high-level screen for project viability and subsidy needs before proceeding to more detailed information gathering, e.g., of GAAP-based reports.

Having a standard template for applicants will also enable comparisons across projects on an apples-to-apples basis and the benchmarking of key metrics, such as cost per location offered service, ARPU, and market share – to identify outliers. Although it is reasonable for different projects to have different operating and financial assumptions – and hence different subsidy needs – having a standard template will ensure that the reasons for the differences can be understood and justified.

**Download Excel version here**

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