Housing Development Feasibility and Costs

WHITE PAPER

Prepared as Part of the
San Francisco Planning Department's

Housing Affordability Strategies

San Francisco Planning

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Development Feasibility White Paper

Introduction

The Housing Affordability Strategies (HAS) project examines how the City of San Francisco can improve housing affordability over the next 30 years, particularly for low- and moderate-income households. The HAS analyzes development feasibility, policies, and investments to achieve San Francisco's housing targets – created both through Mayoral action and the will of the voters – of 5,000 new housing units per year, at least one third of which should be permanently affordable at low and moderate incomes.

This white paper accompanies the main HAS report by providing additional detail on analysis of private housing development feasibility and is followed in the same document with a white paper on development costs. Most housing is produced and operated by the private sector, and private development will likely remain an important component of addressing San Francisco's growing demand for housing. Continued production by the private market depends on individual housing developments being financially feasible before any developer will move forward with a project. The likelihood of housing construction depends on the relationship between development costs and prices/rents, which ultimately determines the financial feasibility of development. A development project is financially feasible – that is, the project "pencils" -- if it accomplishes two objectives:

- Generates a sufficient return on investment (ROI) for the developer and investors (also called "developer return" in this report);
- Allows for a fair "residual land value" for the landowner.

Both of these metrics, ROI and residual land value, are commonly used for testing feasibility using pro forma analysis, as described in the next section.

This white paper explains the financial considerations that drive private housing investments, and how potential policies could help expand those investments and the likelihood of housing production across building types and neighborhoods citywide.

Pro Forma Analysis

Financial feasibility is tested using a "pro forma" statement, or a financial accounting of all expected revenues and development costs associated with a development project. Project revenues appearing in a pro forma (see "Revenues" section later on in this report) may include apartment rents, condominium sales, parking lease revenues, rents from any commercial leasing, or any other revenue that is expected to be generated by the development. Development costs (see "Key Cost Factors" later in this report) usually include the cost of land, direct or “hard” costs such as materials and labor associated with the physical construction, and indirect or “soft” costs, which include all other costs associated with development such as professional services, taxes, insurance, financing costs, and municipal fees. Based on these revenues and costs, the pro forma will calculate an ROI metric that provides a benchmark for project profitability. While there are various technical calculations for ROI that apply in different situations, in concept the ROI represents the profit margin: that is, the net revenue remaining after subtracting all development costs from the project market value.

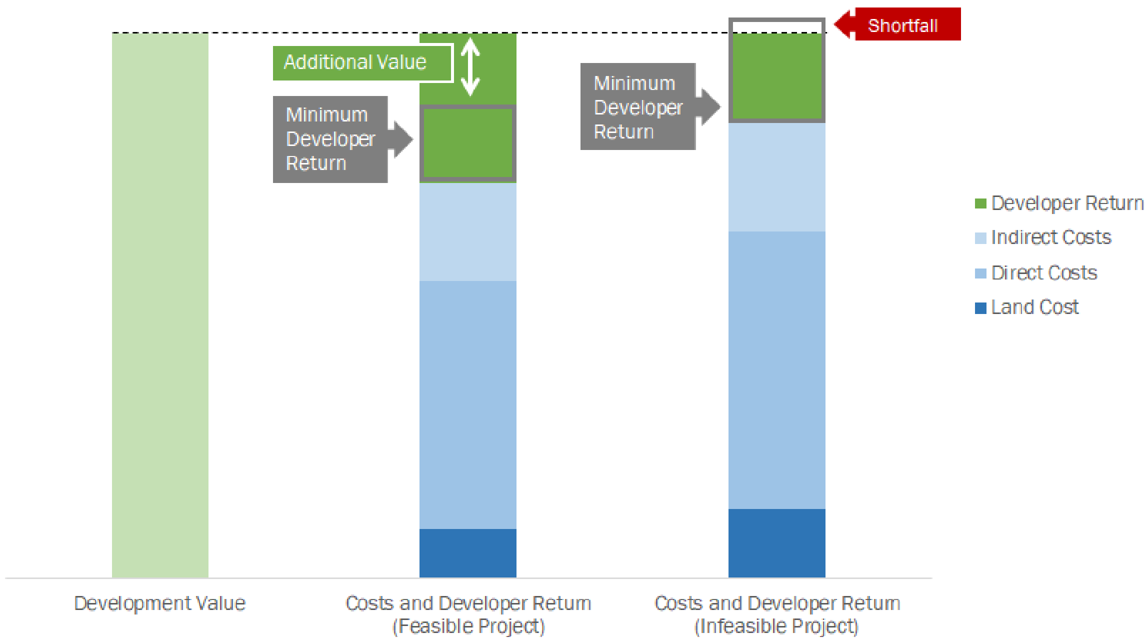
Testing financial feasibility using a pro forma generally takes one of two approaches:

1) Test the return on investment (Figure 1): In this approach, the value of the project is compared to the total costs of the project, in order to solve for the developer return generated by that project. If the project’s value is sufficient to cover all costs, including land, and can also meet the minimum developer return threshold required, then the project is feasible. If there is a shortfall, then the project is infeasible.

2) Test the residual land value (Figure 2): In this approach, a minimum developer return is assumed up front. Using the minimum return, direct costs, and indirect costs as assumptions, the pro forma analysis then calculates the maximum land cost the project could accommodate while remaining financially feasible: this is the “residual land value”. If the residual land value meets or exceeds the market value of the land, it is assumed the typical landowner would be favorable to selling the land, and the project is feasible.

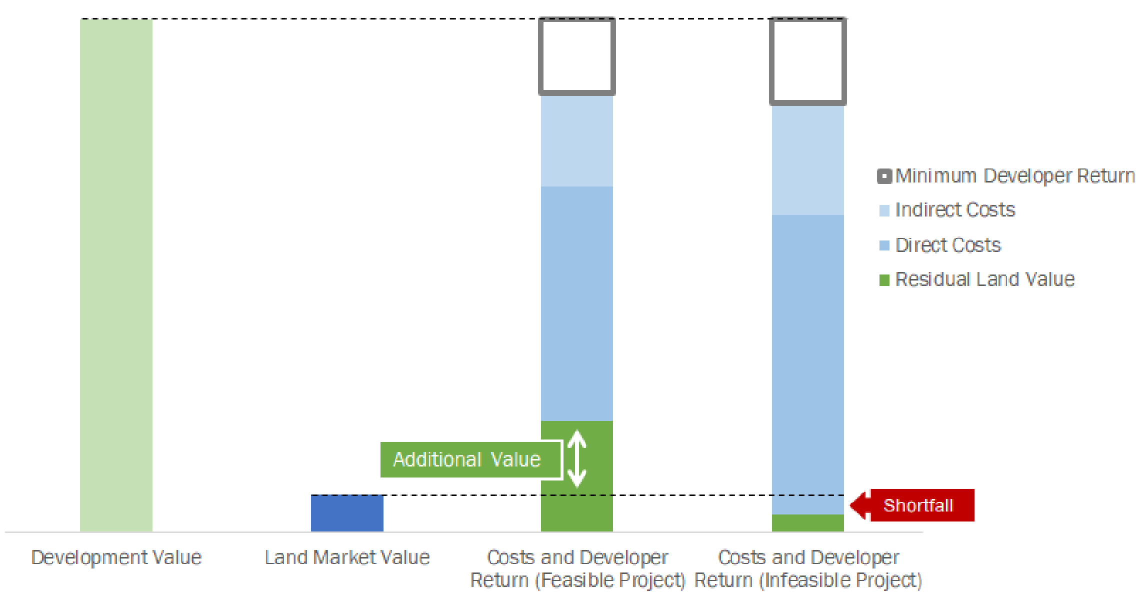
While the above approaches are two different ways of mathematically getting to the same result, each can be useful to highlight either the developer return or land value aspect of feasibility. The following sections discuss in more detail developer return and land value and describe the key factors that influence their threshold values, and thus determine feasibility.

Figure 1: Illustration of Financial Feasibility using Return on Investment



Source: Strategic Economics, 2020.

Figure 2: Illustration of Financial Feasibility using Residual Land Values



Source: Strategic Economics, 2020.

Return on Investment

Real estate development projects rely on a combination of equity and debt financing to provide the capital necessary to move forward on a project. Return on investment is the metric commonly used by developers, lenders, and investors to decide whether to underwrite loans or provide equity. Each of these financing partners has its own thresholds and requirements, as outlined below:

- Lenders. Banks and other institutions that provide debt financing for the project must be satisfied the development project is at low enough risk of default. Lenders will only underwrite loans that meet certain financial performance benchmarks.
- Equity investors. Development projects compete for equity financing in capital markets, where investors are comparing the expected financial risk and return to other real estate projects or other long-term investments in businesses or stocks. The developer will normally be one of multiple equity investors in the project.

Developer return requirements, as determined by these financial partners, depend largely on the project's perceived risk and the length of time before the investment can be recovered. Projects that are larger and more complex, take longer to get approved and built, or have some other degree of risk associated with them, generally require higher expected returns to move forward. Conversely, smaller, less risky projects with short development timelines usually have a smaller hurdle in order to attract investment. For example, a large high-rise project might need to show a 25 percent return after a three-year development period, which, on an annualized basis, would represent approximately eight percent per year (a typical rate of return for many publicly traded stocks).

In San Francisco, while the housing market is very strong, there is also a high perception of risk due to the complex and lengthy entitlements process. High housing prices and robust demand helps to improve investor confidence for new housing development. On the other hand, discretionary review of project proposals can lengthen the period of entitlement or even serve as a roadblock to project approvals. Lenders and equity investors typically require a 15 to 25 percent margin or return above development costs for large scale projects in San Francisco, depending on the specifics of the proposal.

Residual Land Value

In order to see development proceed, new projects must be able to acquire sites at a price that will motivate landowners to sell. The market value of the land for a potential development will vary from site to site depending on a number of factors. One important factor is the value of the current use for the site. Because even underutilized sites such as parking lots or light industrial sites produce income for their landowners, the price required to purchase those sites for redevelopment must entice the owner to forgo an ongoing revenue stream. In addition, California's Proposition 13 limits reassessment of property value, and, as a result, long-time landowners may have very low tax burdens while a sale could trigger capital gains and/or transfer taxes, creating additional considerations for landowners. The specific financial objectives of landowners will vary, and therefore, so will their price threshold.

As discussed in the previous section, land values for new development can be thought of as a residual of the development value after considering costs and developer return. Over time, the average market value of land will respond to changing conditions for development feasibility. As the residual land values for prospective development trend higher or lower than the price levels generally expected by landowners, the market value of land should eventually adjust to the new market conditions, although in practice this adjustment may take some time.

Key Cost Factors

This section includes a discussion of development costs and how they influence development feasibility. Development costs are divided into four categories for this report: direct or “hard” costs, indirect or “soft” costs before impact fees, municipal impact fees, and land cost. (Impact fees are a type of soft cost, but they are itemized separately here because one of the policy tools tested in this analysis involves reducing impact fees.)

Hard Costs

Hard costs include the direct cost of constructing buildings and other improvements on site such as landscaping and infrastructure. Per unit hard costs vary by the type of construction used. Taller buildings with more development intensity are more expensive to build per unit because they require sturdier structural elements, higher standards of fire-proofing, and other amenities such as elevators. Whereas low-rise buildings can be made from less expensive wood frame construction, high-rises must be made from steel and/or reinforced concrete, a more expensive form of construction per square foot. Figure 3 shows a comparison between low-rise, mid-rise, and high-rise building costs. In this study, typical hard costs range from $360,000 per unit for low-rise construction to $450,000 per unit for high-rise construction. Hard costs, which can represent between 50% to 75% of total development costs, do not typically vary by location within San Francisco. Because they are the biggest component of the total development cost, strategies to reduce hard costs are examined in more detail in the second part of this paper.

Soft Costs

Soft costs include indirect costs associated with the project, including professional fees for design and engineering, and other costs such as taxes, insurance, planning and permitting fees charged by the City, and the cost of financing. Not counting impact fees, typical soft costs range from $94,000 per unit for low-rise construction to $109,000 per unit for high-rise construction, or 15% to 18% of total development costs. Soft costs do not typically vary by location within San Francisco, except for impact fees, discussed below.

Impact Fees

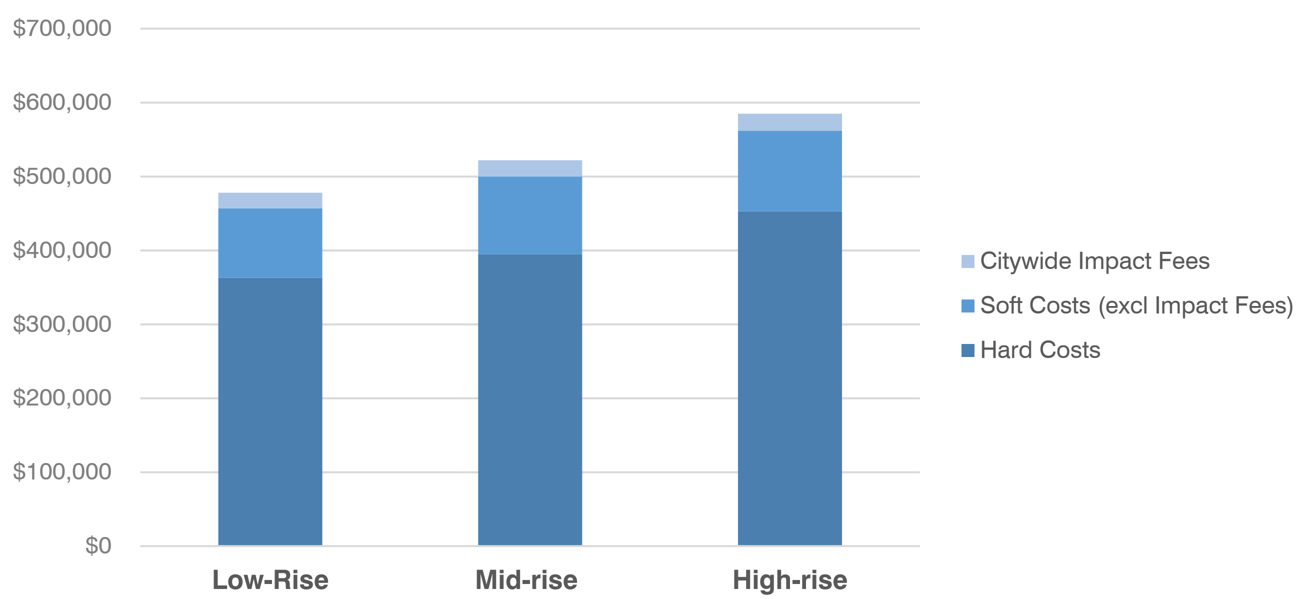
Municipal impact fees are soft costs that have been itemized separately in this analysis: these are fees charged to offset the impact of development on City services and the community at large. This analysis focuses on impact fees charged citywide and excludes special fees charged in designated districts such as special use districts. (In San Francisco, some neighborhoods impose additional fees for affordable housing, neighborhood infrastructure, or other community facilities; these additional fees are excluded from the summary in Figure 3.) Citywide impact fees were estimated to range between $21,000 per unit for low rises to $23,000 per unit for high-rises (three to four percent of development costs) before considering the City's Inclusionary Affordable Housing requirement.

The Inclusionary Affordable Housing requirement can be met by paying a fee, or more commonly, by providing affordable units onsite or offsite. Providing units at below market rates onsite requires the development to accept reduced revenues from the designated affordable units, which cost the same amount to build as a market-rate unit. For larger scale apartment developments (greater than 25 units), the onsite requirement for 2020 in most areas of the city is 20% of total units offered at below market rates. Satisfying the inclusionary requirement at current levels can represent up to 15% of total development costs. In 2020 the Office of the Controller's Office of Economic Analysis will conduct an analysis of the impacts and financial feasibility of current inclusionary housing requirements that can inform elected officials' policy on inclusionary housing.

Land Cost

The cost of land, addressed in the previous section, can vary widely. Generally speaking, land costs are determined by location and the types and intensity of uses allowed by zoning. Both of these characteristics vary significantly for different areas of San Francisco. In this analysis, land value is shown for different areas of the city representing different locational value, and ranges from $200 to more than $1,000 per square foot.

Figure 3: **Typical Development Costs per Unit for Rental Apartment Projects in San Francisco, 2017-2019**



Note: Does not include land costs, which will vary depending on location. Citywide impact fees do not include the costs of satisfying the citywide Inclusionary Affordable Housing requirement, which is reflected in revenues.

Sources: Based on a review of feasibility studies performed for the San Francisco Planning Department between 2017 and 2019. The synthesis of typical cost assumptions above was prepared by Strategic Economics, 2020.

Revenues

Revenue sources for housing development consist of the rents collected (for rental apartments) or sales revenues (for-sale townhomes and condominiums). Some projects have other smaller sources of revenue, including parking leases, and commercial lease revenues in mixed use developments.

This report focuses on rental apartment developments, where the primary source of revenue is apartment rents. The market value of the finished development as a whole is strongly tied to the amount of income the property generates in rent. Because rental revenue is such a big factor in project feasibility and profitability, developers and investors considering a new project pay close attention to the level of rent they believe is attainable. Location matters a great deal for revenues; different areas of the city command different rents based on in their proximity to jobs and transportation, neighborhood services and amenities, and safety and desirability. The rent levels that can be charged for each of these submarkets within San Francisco will vary accordingly. In neighborhoods where the rental market is softer (where demand is lower and rents are less expensive), the revenue potential may not be high enough to make a project feasible, or only the most economical building types (typically lower-density product types) will be feasible. In neighborhoods where the market is strong, per unit revenues are higher, so it is generally easier to get projects to pencil.

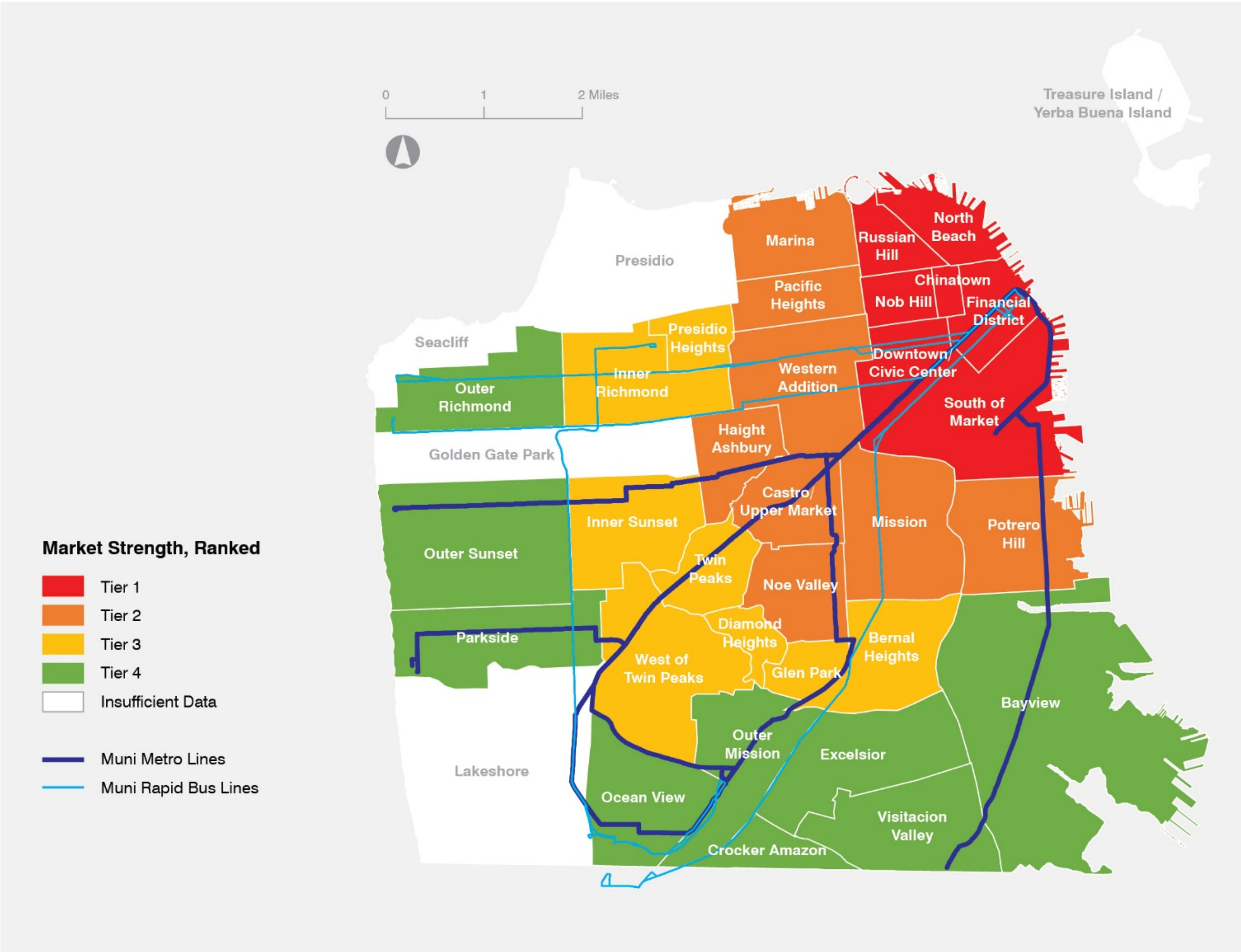
At the same time, higher rent neighborhoods will also see land costs that are elevated in response to these strong market conditions. Because land represents a fixed cost, a higher land cost can be a burden to financial feasibility at lower densities. In such a context, developments will need to achieve a certain density, often with mid- or high-rise towers, in order to be viable. This interaction between rent levels, land cost, and the relative cost of different types of building construction is why high-rise development is often seen in the highest rent areas and low-rise development is usually seen in the lower rent areas. (That said, policy factors such as zoning, fees, and incentives can reshape this pattern such that low rises are sometimes built in high rent areas and vice versa.)

San Francisco Rents by Submarket

The map in Figure 4 illustrates four levels of market strength based on apartment rent data and recent development activity.

- Tier 1 Downtown Core submarkets include the northeastern section of San Francisco where new development activity is strong, including high-rise housing projects. The rents are highest in these areas, due to the proximity to amenities, major transit corridors, and downtown jobs.
- Tier 2 Central Ring submarkets represent areas where rents are not as high as Tier 1 but have attracted low-rise and mid-rise multi-family housing projects.
- Tier 3 Outer Ring and Tier 4 Western and Southern are submarkets where multifamily development has been relatively sporadic. Many of the neighborhoods in these areas are dominated by single-family homes, where larger scale housing development is not permitted.

Figure 4: San Francisco Rental Market Strength by Neighborhood



Source: City of San Francisco, 2019; Strategic Economics, 2020.

Building Type Impact on Revenue

Figure 5 shows some typical rents for four types of large-scale residential buildings: a five-story low-rise, an eight-story mid-rise, and high-rises at two different heights: 14 and 24 stories. The rents on the upper floors of high-rise buildings are assumed to be priced a relative premium because of the views that come with these units. The rent assumptions used in this report reflect these view premiums, which are assumed overall to raise the average rent by five percent for the 15-story high-rise and by twenty percent for the 24-story high-rise.

Figure 5: **Typical New Build Apartment Rents per Month by Submarket and Unit Type**

	Submarket Tier			
Monthly Rent (Market Rate)	*Tier 4*	*Tier 3*	*Tier 2*	*Tier 1*
5-story Low-rise and 8-story Mid-rise				
Per net sf	$3.75	$4.75	$5.50	$6.25
Per unit	$2,719	$3,444	$3,988	$4,531
High-rise, 14 stories				
Rent premium for height	5.0%	5.0%	5.0%	5.0%
Per net sf	$3.94	$4.99	$5.78	$6.56
Per unit	$2,855	$3,616	$4,187	$4,758
High-rise, 24 stories				
Rent premium for height	20.0%	20.0%	20.0%	20.0%
Per net sf	$4.50	$5.70	$6.60	$7.50
Per unit	$3,263	$4,133	$4,785	$5,438

Source: Strategic Economics, 2020.

Dwelling Unit Size Impact on Revenue

The rent per unit in Figure 5 assumes an average unit size of 750 square feet, typical of new developments. Currently, the unit sizes of new developments in San Francisco are trending down, as developers build smaller units to address the challenges of both profitability and affordability of market rate apartments in new build construction. Responding to a market environment where both demand and construction costs are high, developers will often seek to fit more units into a building envelope using smaller and more efficient floor plans or by shifting the mix of units to more studios and one-bedroom units. In this way, more revenue can be generated from the development while managing costs. The resulting smaller units can also be more affordable for renters or buyers who are willing to accept less space.

Most of San Francisco's residential land is subject to fixed density controls where the number of units are set based on the lot size, and this reduces developer flexibility to provide smaller, cheaper units. In the few parts of San Francisco that do not have such density limits, form-based controls such as rear yard and open space requirements, height and set-back requirements, and requirements for multibedroom units determine the number of homes in a building.

Feasibility of Residential Development in San Francisco Today

Despite extremely strong demand for housing, development feasibility is a challenge for many parts of the Bay Area, including in many areas of San Francisco. In recent years, rising development costs region-wide have outpaced the rate of growth in rents, which has hampered production. According to an industry survey from Turner and Townsend, San Francisco had the highest construction costs in the world in 2019, and costs are escalating by five to six percent per year. These elevated costs have posed a challenge to development region-wide, and in San Francisco new development proposals tend to be in limited areas where market rents are the highest in the region.

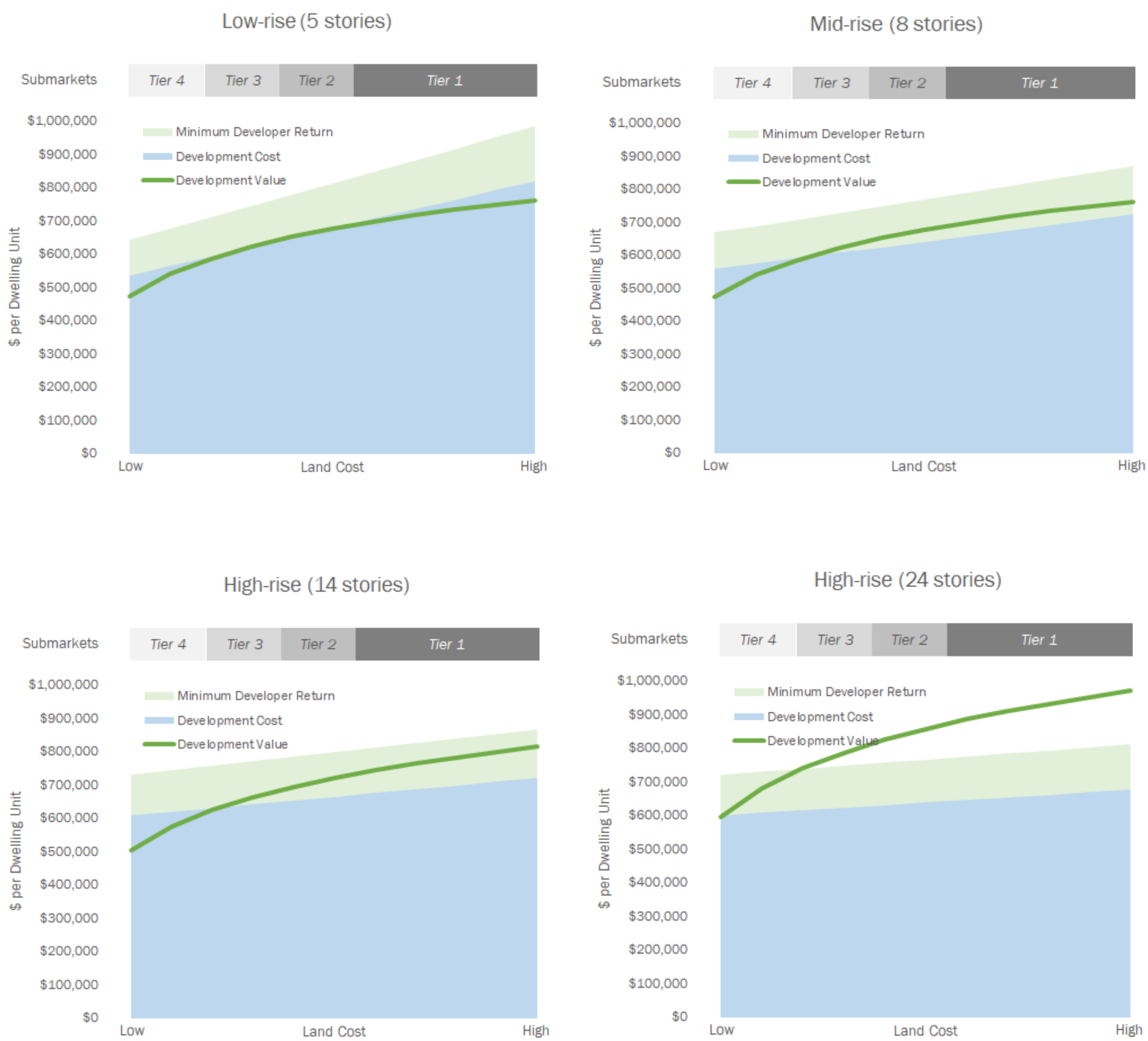
These high costs are mainly a result of labor shortages, particularly for skilled labor (see section on Development Costs.) As a secondary factor in rising costs, San Francisco and many other Bay Area cities have stepped up development requirements, such as inclusionary housing and impact fees, adding to total development costs. Many of these new requirements are themselves aimed at increasing the rate of affordable housing production. While these additional requirements are often designed to capture the added economic value created by strong market conditions and/or recently upzoned areas, their effect can be to reduce developer profits to levels that are infeasible for development.

Using the cost and rent assumptions shown in Figures 3 and 5, respectively, Strategic Economics developed a basic pro forma model to test the feasibility of typical developments for the building types and submarket tiers introduced in the previous section. Figure 6 expresses the result of this analysis, illustrating the general pattern of feasibility for these development scenarios in the current market environment. (Note that costs include fees and other City requirements. Circumstances for actual developments vary widely and financial feasibility for any particular development may diverge from the overall pattern shown.)

As shown in Figure 6, taller high-rises are generally feasible in submarket Tiers 1 and 2 under current market conditions, construction costs, and City fees and requirements. High-rises may also be feasible in submarket Tier 3, although it would be unusual to proceed with this type of development intensity in San Francisco's lower density neighborhoods, as historically, zoning rules have prevented this. All other development types are not financially feasible under typical conditions in the current market environment. This pattern generally reflects recent trends: most new, large scale development activity occurs in the northeast portion of the city.

Figure 6: Development Feasibility by Building Type and Submarket

(Developments are feasible where development value exceeds development costs and a minimum developer return)



Source: Strategic Economics, 2020.

Policy Tools

The City could consider a range of policy tools to ease development costs and stimulate production both in a wider range of building types and in more submarkets. The section below contains a discussion of how the development economics could shift in response to policies aimed at stimulating more large-scale multifamily development, particularly along transit corridors in San Francisco where development is currently stagnant. Following that is a discussion of the potential for allowing smaller-scale (less than 25 units) infill development in areas currently dominated by single-family homes.

Reducing Cost of Development for Large Scale Projects (At least 25 units)

Strategic Economics tested two policy concepts designed to improve financial feasibility by reducing the cost of development. The policy concepts are as follows:

- Update regulations to facilitate lower cost building technologies. As the construction innovations become more widespread, and more production facilities become active, the adoption of mass timber and modular construction could reduce hard costs by between 15-30%, according to estimates from developers and contractors. Construction technologies that decrease costs will result in more feasible building types in the strongest markets. As shown in Figure 7, more building types become feasible or marginally feasible in submarket Tiers 1 and 2. (In Tier 1, the mid-rise is marginally feasible and the 14-story high-rise is feasible, an improvement over the Base Case; in Tier 2, the low-rise, mid-rise, and 14-story high-rise are all estimated to be marginally feasible.) In addition, the 24-story high-rise became feasible in submarket Tier 3.

- Reduce impact fees. Citywide impact fees are estimated to be, on average, approximately $25 per gross square foot of building area, excluding the inclusionary affordable housing requirement and any special area fees. Because citywide fees represent a relatively small portion of development costs, reductions to these fees would have only a modest impact on development feasibility (see Figure 7) but may help stimulate production in combination with other incentives.

Investments in Infrastructure and Amenities

In addition to cost reductions, future City investments in infrastructure and neighborhood amenities could help support new housing development in Tier 3 and Tier 4 submarkets. Implementing the two policy concepts alone were insufficient to create financial feasibility in Tier 3 and Tier 4. In these areas, the City investment in infrastructure and improving neighborhood amenities could increase the quality of life and appeal of these neighborhoods and catalyze development of both market-rate and below market rate housing.

Encouraging "Small Scale Infill" in Neighborhoods

In addition to providing cost relief to large scale developments, the City is also considering other ways of stimulating private development, such as by encouraging smaller scale multifamily projects in "infill" locations in existing residential neighborhoods. Rezoning those neighborhoods in San Francisco where currently single-family homes predominate could create significant new opportunities for small scale development. Many neighborhoods in San Francisco are parcelized with small lots, making it difficult to assemble the land required for larger projects.

Keyser Marston Associates performed a case study analysis of the patterns of small-scale development since 2010. The study found that this type of development had the following characteristics:

- It was more common to develop on parcels that were either vacant or had a commercial use. The demolition of structurally sound single-family homes for redevelopment was rare. If small scale infill development opportunities are limited to vacant and commercial parcels, the potential for significant new housing production may be limited.

- Among the three neighborhoods analyzed over the study period (Richmond, SoMa/Hayes Valley, and the Mission), small scale infill projects produced approximately half of all new housing units in the Richmond, where parcelization and zoning inhibit larger scale projects. In the Mission and SoMa/Hayes Valley, where larger projects are common, small scale infill projects represented just 2.7 percent of new units. Larger scale development is permitted in more parts of the east side of San Francisco than in the west or south side, and this may result in a higher likelihood of smaller parcels assembled into larger developments.

- The majority (81 percent) of small-scale developments were able to avoid inclusionary requirements either because their unit counts were too low to trigger the requirement (less than 10 units) or by qualifying as student housing.

- The new units produced by small scale infill development are not typically affordable to a middle-income family. Both rental and ownership units were priced at levels above what the City considers to be affordable to middle income households.

Figure 7: Developer Return on Investment by Building Type and Submarket Tier

Base Case Conditions

	Low-Rise (5 Stories)	Mid-rise (8 Stories)	High-rise (14 Stories)	High-rise (24 stories)
Tier 1	-9%	5%	12%	43%
Tier 2	6%	8%	8%	34%
Tier 3	-3%	-4%	-4%	17%
Tier 4	-15%	-18%	-19%	-3%

Policy: Facilitate Construction Technologies to Reduce Hard Costs

	Low-Rise (5 Stories)	Mid-rise (8 Stories)	High-rise (14 Stories)	High-rise (24 stories)
Tier 1	2%	19%	26%	62%
Tier 2	19%	22%	23%	51%
Tier 3	9%	9%	8%	32%
Tier 4	-4%	-7%	-9%	10%

Policy: Reduce Citywide Impact Fees

	Low-Rise (5 Stories)	Mid-rise (8 Stories)	High-rise (14 Stories)	High-rise (24 stories)
Tier 1	-5%	10%	16%	49%
Tier 2	11%	13%	13%	39%
Tier 3	1%	1%	0%	22%
Tier 4	-11%	-14%	-16%	1%

Key

Feasible (Developer Return is greater than 25%)	xx%
Marginal (Developer Return is between 15 and 25%)	xx%
Infeasible (Developer Return is less than 15%)	xx%

Source: Strategic Economics, 2020.

Development Costs White Paper

Introduction

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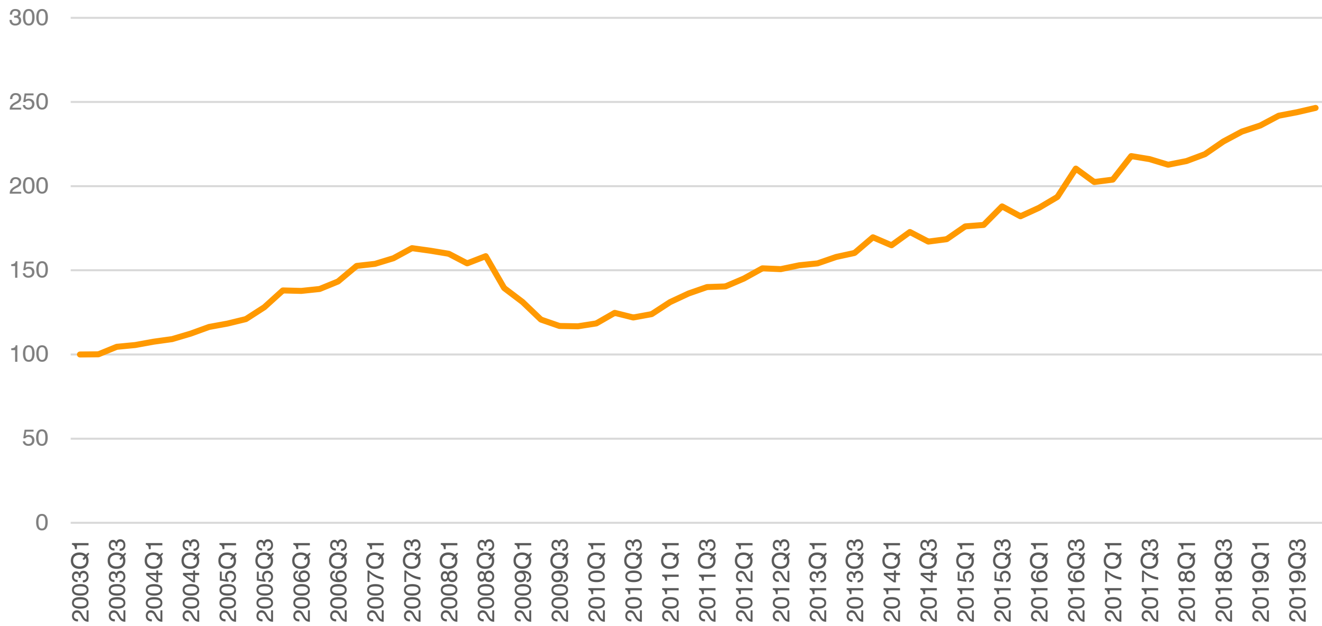
Construction Cost Trends

Construction costs in San Francisco have been rising steadily in the last decade. According to a recent survey of construction costs from Turner and Townsend, San Francisco has the highest construction costs in the world.[1] The construction cost for high-rise apartment housing was estimated at $350 per square foot, compared to $307 per square foot in New York, and $218 per square foot in Seattle, the next two hottest development markets. Construction industry experts are projecting continued cost inflation of between 4.5 and 7.0 percent in San Francisco in 2020.[2]

However, actual construction costs are not always in line with the selected labor and materials cost items that are reflected in most construction cost indices, because construction bids from general contractors and subcontractors can vary dramatically depending on economic conditions and labor availability. The TBD Bid Index tracks the changes in construction bids, which are usually much more volatile than other more generalized construction cost indices. The TBD Bid Index finds that construction bids have escalated rapidly since the Great Recession, at a compounded annual growth rate of 7.3 from 2011 to 2019. By comparison, the annual cost escalation from 2003 to 2010 was 2.7 percent.

Figure 1: **Construction Bid Index, 2003-2019**



Source: TBD Consultants, Construction Bid Index.

Factors that are affecting construction costs include the following:

Lack of experienced construction personnel. Nationally, the construction industry lost 2.2 million jobs during the Great recession.[3] As the number of projects dried up, many workers chose to retire earlier, or found new jobs in different industries. The labor shortage has persisted, partly because there are insufficient job training opportunities for the next generation of workers. Building up the workforce takes time. Meanwhile, new entrants to the construction industry are less experienced, and therefore less efficient, which has an impact on costs.

Lack of competition, especially at the subtrade level. Because of the shortage of skilled labor, there are few competitive bids from sub-contractors in specialized trades. This shortage of qualified and available subcontractors has driven up bids for new development projects.

The amount of construction activity in the Bay Area is contributing to the shortage of labor and subcontractor firms. There is a large volume of large public sector projects underway in the Bay Area, including transit expansions and school/hospital upgrades statewide; private commercial developments led by major tech employers; and other development projects.

Potential new tariffs on construction materials could also drive up costs. In San Francisco, it is estimated that 2018 tariffs on steel increased the price of some materials by 17 percent.[4] While the May 2019 trade agreement with Canada and Mexico lifted tariffs on steel imported from these countries, there is still uncertainty about the impact of future trade policies on building materials in the future.

Innovative Technologies

The introduction of innovative technologies such as modular construction and mass timber have the potential to greatly reduce the cost of housing construction.[5]

Modular development is a construction approach of manufacturing units offsite. While the modules are constructed in a factory, the construction site can be prepared. Once the modules are completed, they are loaded and transported to the construction site, and then assembled on-site. The assembly process is estimated to take about six to eight weeks, a much shorter time frame than conventional construction. Modular development methods have the potential to reduce construction costs in projects, due to savings on time and labor. One modular firm based in the Bay Area, for instance, has cited that their projects have a 30 percent reduction in construction cost.

Cross-laminated timber (also known as mass timber) could also dramatically reduce construction cost for residential buildings. CLT refers to an engineered wood product, which is made by stacking and pressing layers of 2x4 and 2x6 lumber to form larger panels. CLT panels can be anywhere from four to 20 inches thick, four feet to 12 feet wide, and 60 feet or longer. While this technology has been used in Europe since the 1990s, it has only recently been introduced in the United States. Because these new technologies are fairly untested in the U.S., they are presently more expensive than traditional Type V wood construction. However, this dynamic is forecast to change in the next five to ten years, as building codes are updated and the production scales up.

Mass timber provides a variety of advantages compared to conventional residential construction[6]:

- CLT panels are comparable in performance to steel and concrete, but have a lower carbon footprint, and allow for the construction of higher buildings than traditional wood-frame construction.
- CLT panels are stronger and more resilient to fire and earthquakes than conventional construction types and can be used for a variety of construction applications (floor, roof, and wall).
- Because mass timber is manufactured off-site in a controlled factory environment, the on-site labor required is significantly lower, which drives down the overall cost of construction.
- On-site construction schedules are up to 40 percent faster, because the systems can be assembled more quickly than conventional construction.[7] The faster construction period lowers the cost of financing for the development.

However, there are constraints that inhibit the use of these new construction technologies more widely.

Cost and scale of production. According to DCI Engineers, the number of suppliers in North America has grown from only 2 in 2011 to 7 by 2019. However, most suppliers are in Canada, Washington, and Oregon, and the cost of transportation from the factories to job sites is significant.

Financing/underwriting. Obtaining financing can be a major obstacle to building modular housing, as lenders view modular projects to be more risky than traditional construction. In addition, developers need to make significant upfront capital investment for both modular and CLT, which is challenging for most development projects.

Building codes. The City's existing building codes do not encourage the use of mass timber and may even prohibit it for buildings over 8 stories.

Labor. New construction jobs will need to be of equal or better quality than conventional construction jobs in order to be an equitable strategy for improving affordability. Workforce development programs in the construction industry are needed, both for conventional housing development and for preparing workers for off-site manufacturing and construction jobs using these newer technologies.

Strategies to Reduce Development Costs

As mentioned in the feasibility section, there are a variety of policy tools available to the City that could ease development costs significantly by removing barriers to the use of new technologies and increasing the size of the construction labor force.

Update regulations to facilitate mass timber and modular construction. The City of San Francisco can put policies in place to facilitate the transition to new construction technologies by updating building codes and permitting processes. San Francisco's building code would need to adopt new standards consistent with the Universal Building Code, in order for mass timber to be implemented at a larger scale, especially for taller buildings.

Workforce development. The City of San Francisco can coordinate with community-based organizations, labor, and workforce training programs to ensure that there is a growing pipeline of workers and sub-contractors prepared for off-site manufacturing and construction jobs using newer technologies. The City could also consider shorter term strategies to house construction workers as a way to attract construction labor to the city and metropolitan area.

Endnotes

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