The Lifecycle Cost Adjustment Methodology: An Exploration of the Baseline and Alternative Assumptions

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Executive Summary

This paper provides a detailed look at the methodology behind a new approach for estimating the costs of developing and maintaining affordable multifamily rental housing over the course of a property's lifecycle. We refer to the new approach as "lifecycle cost analysis" or "lifecycle underwriting." We use the term "lifecycle cost adjustment" to refer to the adjustment to initial total development costs needed to ensure viability over the property's full lifecycle.

Lifecycle underwriting can help developers and other interested parties estimate the likely viability of a specific project over its full lifecycle by adjusting the total development costs to include the expected costs of all major replacements that would be needed over a property's usable life. The methodology also allows an on-par comparison of the costs of different forms of development notwithstanding differences in their financial structure and other development decisions. The lifecycle cost adjustment is calculated based on a property's estimated capital needs, available replacement reserves, and other resources (cash flow and refinancing proceeds) to determine whether the property has the necessary resources to maintain its building systems over a full 50-year lifecycle. If the property's resources would not be sufficient to replace building systems as they age, a lifecycle cost adjustment is added to the total development costs. This amount is equal to the additional initial reserve deposit that would have allowed the property to meet its capital needs over the full course of its lifecycle. We refer to the sum of the lifecycle cost adjustment and total development costs as Adjusted Total Development Costs (Adjusted TDC or ATDC).

Applying this methodology to a convenience sample of 269 affordable multifamily rental properties, we found that 127 properties (47 percent) were not able to meet their capital needs over a 50-year period and therefore required a lifecycle cost adjustment. The median lifecycle cost adjustment for these 127 properties was $5,412 per unit, while the median ATDC per unit for all properties was $138,596.

We also tested the sensitivity of our methodology to some of our assumptions, such as the analysis period length, the use of cash flow or net refinancing proceeds to supplement replacement reserves, and the use of other (non-replacement) initial reserves for capital needs. Shortening the 50-year analysis period to 30 or 40 years had little to no effect on the number of properties that needed a lifecycle cost adjustment. Changing our assumption about the use of cash flow or refinancing resulted in a substantial increase in the need for an adjustment. Finally, allowing properties to tap into other initial reserves (operating reserves, for example) had a complex effect. By delaying the first reserve deficit, it also delayed the first use of cash flow or refinancing. In some cases, this increased the size of the lifecycle cost adjustment or affected a property's ability to self-finance to cure a replacement reserve deficit. Other alternative assumptions and their effects are described in this paper.

For those who want to apply lifecycle underwriting to a specific property, the Compass Group[1] has developed a web application, L-Cycle, that allows users to input financial data, adjust assumptions, and obtain estimates of whether a property is likely to successfully fund its long-term capital needs using any

[1] The Compass Group is a member of the study team along with the Center for Housing Policy and Summit Group. Compass provided expertise on multifamily housing finance. The Summit Group provided statistical support.

of three different scenarios: using the planned replacement reserves without additional funding, adding funds from cash flow, or adding the net proceeds of refinancing. The web tool is available at www.HousingPolicy.org/Lcycle. A separate working paper applies this methodology to compare the costs of developing and maintaining affordable multifamily rental property through two different development approaches: acquisition-rehab and new construction.[2]

[2] See *Comparing the Costs of New Construction and Acquisition-Rehab in Affordable Multifamily Rental Housing: Applying a New Methodology for Estimating Lifecycle Costs*. Available at: www.nhc.org/media/files/CostComparison_NC_AR.pdf

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Introduction

This paper provides a detailed look at the methodology behind a new approach for estimating the costs of developing and maintaining affordable multifamily rental housing over the course of a property's lifecycle. We refer to the new approach as "lifecycle cost analysis" or "lifecycle underwriting." As described in a separate working paper, we applied this approach to compare the costs of two forms of producing affordable multifamily rental housing: new construction and acquisition-rehab. The methodology also provides the basis for L-Cycle, an online Lifecycle Cost Modeling tool which allows users to understand the ability of a property to meet its expected capital needs over its full lifecycle.[1]

Lifecycle underwriting looks at a property's estimated capital needs, available replacement reserves, and other resources (cash flow and refinancing proceeds) to determine whether the property has the necessary resources to maintain its building systems over a full 50-year lifecycle. If the property's resources would not be sufficient to replace building systems as they age, a lifecycle cost adjustment is added to the total development costs. This amount is equal to the additional initial reserve deposit that would have allowed the property to meet its capital needs over the full course of its lifecycle. We refer to the sum of the lifecycle cost adjustment and total development costs as Adjusted Total Development Costs (Adjusted TDC or ATDC).

This paper describes the concepts that underlie lifecycle underwriting and examines the implications of the methodology by applying it to a sample of 269 properties. We also examine the sensitivity of the methodology to assumptions utilized in our model and, finally, provide a set of policy implications.

The Adjusted Total Development Costs Concept

ATDC combines total development costs with a lifecycle cost adjustment designed to ensure that properties have sufficient funds available to meet their estimated capital needs over a specified lifecycle (namely, 50 years). The calculation provides a window into the long-term viability of an affordable multifamily rental property.

The ATDC concept also permits an apples-to-apples comparison of the costs of developing and maintaining affordable multifamily rental properties, notwithstanding differences in development approach, financial structure, and other development decisions. The adjustment accounts for differences in initial unit quality—for example, between an acquisition-rehab project that did not update all of the building systems and one that did—as well as differences in financial structure, such as initial and ongoing reserve deposits, that affect how well properties can meet their ongoing capital needs.

This section provides details about the calculation of total development costs and the lifecycle cost adjustment.

[1] L-Cycle is available at www.housingpolicy.org/lcycle

Total Development Costs

Total development costs include all costs necessary to produce a multifamily housing development that is completed and leased-up. These costs include land, construction, developer fees, lease-up costs, and other soft costs such as construction-period interest, architectural fees, engineering fees, legal fees, and permit costs. The treatment of some of these costs merits further explanation.

- *Actual acquisition costs*. We included the actual amounts paid as part of acquiring a site for development. For new construction projects, actual costs included the amount paid to acquire the land. For acquisition-rehab projects, actual costs included the amount paid to acquire the land and buildings. It is our experience that actual cost typically (though not always) reflects fair market value. In some cases, the actual acquisition cost could exceed fair market value[2] and in others, the actual acquisition cost could be below fair market value,[3] but we have a limited ability to accurately identify and correct for these variations.

- *Full developer fee.* We included the full developer fee in total development costs, whether or not that fee was paid in cash during the development period or deferred to be paid later from cash flow. Because of accounting requirements, there was a reasonable expectation that the deferred fee would be paid from future cash flow. Therefore, the developer would expect to receive it, and we treated it as a legitimate part of the development costs.

- *Reserves.* We included in total development costs any initial deposits to reserves (which might include deposits to a replacement reserve, a debt service reserve, and/or an operating reserve). For acquisition-rehab projects, we reduced total development costs by any existing replacement reserve balances. We thus included in total development costs any <u>increase</u> to existing replacement reserve balances.

- *Net rental income during construction.* It is common, but by no means universal, for apartment properties to generate rental income during the construction period.[4] In our analysis, we

[2] Actual acquisition cost could be higher than fair market value if the purchaser and seller are related entities. We doubt a research protocol could be developed that would be effective in detecting these cases, since the related parties would have a strong incentive not to admit that the purchase price had been overstated.

[3] Actual acquisition cost could be lower than fair market value if the seller was motivated partly or primarily by mission rather than financial concerns. In our research, we asked data providers follow-up questions whenever the acquisition cost fell below $10,000. Of the 42 properties in the initial analysis, four had very low land cost. Land was donated to two of these projects, and (if we could obtain a sound estimate of value) these two projects would be candidates for an upward adjustment in total development costs. The remaining two projects leased rather than purchased their land; the lease arrangements are complex in each instance, and more research would be needed in order to determine whether the operating costs in the database accurately reflect the owner's obligations to pay ground rent.

[4] Whenever it is possible to temporarily relocate tenants during rehab, an acquisition-rehab project can collect significant rental income during the construction period. For both acquisition-rehab and new construction projects, net rental income is also generated whenever some buildings are ready for occupancy prior to the end of the

excluded any net (positive) rental income collected during the construction period, because we treated it as a source of funds and not as a reduction of development cost. If net rental income during the construction period is negative (that is, operating expenses exceed collected rental income), we treated the shortfall as part of total development costs.

- *Predevelopment costs.* Predevelopment costs, such as staff costs to acquire the site, pursue local approvals, and pursue financing, were not reflected separately in total development costs. The rationale for this was that once a project goes forward, all predevelopment costs become actual project costs and are included in total development costs.[5]

Lifecycle Cost Adjustment: Calculation Methodology

To determine whether a property needs a lifecycle cost adjustment, we compare the long-term capital needs for each property with the full range of resources (reserve funding, cash flow, and refinancing) available to pay these costs. If the resources are inadequate, we then calculate the amount of additional up-front investment that would need to be deposited into the reserve in order to have adequate resources for the property's lifecycle. We refer to this as the lifecycle cost adjustment and in the section below, we briefly describe the methodology used to calculate it. A more detailed description of this calculation is provided in Appendix A.

Our estimates of properties' long-term capital needs are based on:

- The age of the building systems[6], and

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construction period. This would be very common for garden apartment properties due to the standard practice of staggering the construction start and completion dates of various buildings in the interest of an efficient construction process. Conversely, if a new construction property consists of a single building, there would be no rental income during the construction period, because all units would become ready for occupancy at the same time (i.e., at the end of the construction period). The same would be true of an acquisition-rehab property consisting of a single building, when the nature of the rehab requires the building to be vacated during the construction period.

[5] Our view is that staff costs incurred in predevelopment activities are included in total development costs via the developer fee, which compensates the developer for predevelopment activities as well as for overhead costs and for the risks inherent in developing the property.

[6] We assume that systems are new at the time of construction for new construction projects or if they were replaced during rehab. Systems not replaced during rehab are assumed to have been replaced at the end of their useful lives. For example, for a property originally constructed 20 years prior to the time of rehab, air conditioners (15 year theoretical useful life) were assumed to have been replaced after 15 years, and the replacement air conditioners were assumed to have been 5 years old at the time of rehab. If a system was not replaced during rehab but its useful life would have ended in the first five years after rehab, it is assumed to have been replaced two years prior to the year of rehab.

- The anticipated costs of replacing building components during the specified lifecycle.[7]

We estimate properties' available resources based on:

- Any initial deposit into the replacement reserve (one of the components of total development costs),
- The annual deposits into the replacement reserve, and
- A project's ability to generate cash flow or refinancing proceeds to fund any replacement costs that cannot be funded from the reserve.[8]

Based on replacement estimates and reserve deposits, we calculate a reserve balance each year over the property's lifecycle. The reserve balance for any year equals:

- The beginning reserve balance,
- *Plus* the annual deposit to the replacement reserve[9],
- *Plus* interest earnings[10],
- *Minus* withdrawals to pay for system replacement costs.

A lifecycle cost adjustment is calculated if there is a negative ending reserve balance in any year. In cases of a negative reserve balance, larger and smaller lifecycle cost adjustments would exist under three different scenarios:

(a) Not using any cash flow or refinancing strategies to supplement the available reserve funding,

(b) A "cash flow" strategy in which all project cash flow is deposited into the reserve starting five years prior to the year in which the first negative reserve balance occurs, and

(c) A "refinancing" strategy in which we assume refinance occurs two years prior to the year in which the first negative reserve balance occurs, with net refinancing proceeds[11] being deposited into the reserve.

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[7] Assumptions for the estimated useful life and replacement cost for each major building system are based on information from On-Site Insight, a capital planning firm specializing in analysis of affordable rental housing. The model includes three separate sets of cost assumptions, for properties located in low-, medium-, and high-cost areas. All costs are reported in 2009 dollars.

[8] The use of cash flow and refinancing proceeds to cover replacement costs is discussed further in a later section on cash flow and refinancing assumptions.

[9] Our model assumes the annual reserve deposit is increased each year for inflation.

[10] Our model assumes the beginning reserve balance earns interest at a passbook rate.

[11] The model estimates net refinancing proceeds as follows: the maximum loan amount that the model estimates the project could support (at a 1.50:1 debt service coverage ratio, 9.0 percent interest rate and 25 year

If the cash flow or refinancing strategy resolves the negative reserve balance, our methodology assumes no lifecycle cost adjustment is necessary. In other words, we assume that cash flow and refinancing proceeds are available to cover the costs of system replacements if the replacement reserve is not enough.

In applying this analysis to a convenience sample of 269 properties (discussed in more detail later in this paper), we found that around half of all properties did not require a lifecycle cost adjustment. Taken from a different angle, about half the studied projects had enough in reserves, generated sufficient reserve deposits or cash flow, or had sufficient ability to refinance to cover expected capital costs over the 50-year analysis period. This finding opens up a number of policy questions that will be addressed later.

Adjusted TDC

We add a property's lifecycle cost adjustment to its total development costs to calculate ATDC. As a stand-alone measure, ATDC provides an estimate of the costs of developing and maintaining an affordable multifamily rental property over a full lifecycle. For our cost comparison analysis (described in a separate working paper), ATDC places all projects on a level playing field[12]—regardless of how a property was produced—allowing us to evaluate the true cost differences between acquisition-rehabilitation and new construction.

Assumptions

The baseline assumptions used in the calculation of total development costs and the lifecycle cost adjustment are described, in brief, in Table 1. The rationale for these assumptions is described after the table. A subsequent section of this working paper describes alternative approaches to these assumptions and their effect on ATDC.

amortization term), minus the outstanding principal balance of any existing standard commercial first or second mortgage loan.

[12] All costs are inflation-adjusted to 2009 dollars.

Table 1: Baseline Assumptions	
Issue	**Assumption**
1. General Inflation Rate	2.0% for rents, 2.5% for everything else
2. Stress Testing	None
3. Analysis Period	50 years
4. Deferred Developer Fee	100% is included in total development costs
5. Treatment of Cash Flow and Refinancing	Cash flow or refinancing proceeds are used for capital expenses if there would otherwise be a replacement reserve deficit.
6. Capital Needs Escalation	None
7. Capital Needs Accrual	Calculate capital needs on a cash basis.
8. Initial Reserves	Include only amounts designated for the replacement reserve.
9. Replacement Reserve Deficits in Multiple Years	A replacement reserve deficit in any year contributes toward the lifecycle cost adjustment.
10. First Replacement	No major building system will require replacement during the first five years of the analysis period.
11. Replacement Costs	Sourced from On-Site Insight. Includes costs for low-, medium- and high-cost areas.
12. Replacement Quantity Formulas	Sourced from On-Site Insight. Considers factors such as the number of units in the project and the average unit size in square feet.
13. Passbook Interest Rate	1.50%
14. Long-Term Treasury Interest Rate	5.00%
15. Refinancing Terms	1.50:1 debt service coverage ratio, 9% / 25 years

General Inflation Rate. Our analysis utilizes 2.5 percent as an estimate of the rate of future inflation; we believe this estimate falls within the range of predictions by economists. We also assume that rental revenue will increase at a slower rate; this reflects standard underwriting practice in the affordable rental housing industry. There are two reasons for this standard underwriting practice of "trending" rents at a lower annual rate than expenses. One is that rents for affordable housing properties are often based on area median incomes or other formulas that may grow more slowly than the rate of general inflation. Another is that although rents for new properties should keep pace with inflation, rents for any given property should (in theory) grow slower than inflation as a result of the property's loss of competitive position as it ages.[13]

Stress Testing. We do not include stress testing (in which expenses grow faster than revenues) in our standard assumption set. Instead, the model permits increases in the rent loss percentage (for example,

[13] Another way of reaching the same conclusion is to consider that, over time, average rents should keep pace with inflation, but as any individual property ages, its competitive position relative to the average property in the market will decline. Thus, rents for an individual property should grow more slowly than the rate of general inflation.

selecting two percent would increase the rent loss for each project by two percentage points above the rate included in the input data) or in the operating expenses (for example, selecting ten percent would increase each operating expense by ten percent above the amount in the input data).

Analysis Period. A 50-year lifecycle is our best estimate for the typical useful life of an apartment property before redevelopment may be required.[14]

Deferred Developer Fee. We include the full developer fee in total development costs, whether or not that fee is paid in cash during the development period or deferred to be paid later from cash flow. Because of accounting requirements, there is a reasonable expectation that the deferred fee will in fact be paid from future cash flow and should therefore be considered a legitimate part of a project's development cost.

Treatment of Cash Flow and Refinancing. Our baseline assumption is to calculate a lifecycle cost adjustment that is the lowest of three scenarios: (a) without considering cash flow or refinancing potential; (b) depositing excess cash flow into the reserve starting five years before the first deficit appears; and (c) refinancing the project two years before the first deficit appears. Our impression of industry asset management practice supports the assumption that owners would refinance or redirect cash flow into the reserves in order to avoid a reserve deficit.

Capital Needs Escalation. Our baseline assumption is that future replacement costs are equal to current replacement costs plus inflation.

Capital Needs Accrual. The baseline assumption calculates capital needs on a cash basis. This means that our definition of capital needs includes only the systems that are assumed to be replaced during the analysis period, based on an estimate of their useful life. We have chosen this as the baseline approach because it most accurately reflects the actual costs of operating the property over the analysis period.

Initial Reserves. The baseline assumption is that the replacement reserve is the only reserve fund used to pay for capital needs over the course of the analysis period. We take this approach because in our sample dataset, the initial reserve deficit typically occurs some years after development, at a time when other initial reserves may well have been distributed to the sponsor or used for other purposes.

Replacement Reserve Deficits in Multiple Years. The baseline assumption is that any reserve deficit that occurs during the analysis period and cannot be resolved with cash flow or refinancing can contribute toward the lifecycle cost adjustment. If deficits occur in multiple years, the property's lifecycle cost adjustment corrects the deficit that requires the largest adjustment to the initial replacement reserve. This is usually, but not always, the final year of the analysis period.

[14] It is useful to consider the competitive status of typical apartment properties developed 30, 40, and 50 years ago. Properties developed 30 and 40 years ago are still likely to be competitive in their original physical configurations. However, properties developed 50 years ago (or more) are likely to have bedrooms, kitchens, and bathrooms that are too small, and/or have fewer bathrooms than are needed, to be competitive today, requiring expensive reconfiguration ("redevelopment") to cure what the real estate industry calls "functional obsolescence."

First Replacement. The baseline assumption is that for acquisition-rehab projects, no major building system will require replacement during the first five years of the analysis period.[15] Systems that would appear to be due for replacement in the first five years are assumed to have been replaced two years prior to the start of the analysis period.

Replacement Costs. Replacement costs for each major building system were sourced from On-Site Insight, a leading provider of capital planning services to the multifamily industry. On-Site Insight provided replacement costs for low-, medium-, and high-cost areas.

Replacement Quantity Formulas. Formulas for estimating the quantity of replacements for products like carpet or tile were sourced from On-Site Insight. These formulas take into account factors such as the number of units in the project and the average unit size in square feet.

Passbook Interest Rate. A passbook interest rate of 1.50 percent corresponds to our baseline rate of general inflation.

Long-Term Treasury Interest Rate. A long-term Treasury interest rate of 5.00 percent corresponds to our baseline rate of general inflation.

Refinancing Terms. We use conservative assumptions regarding refinancing: a 1.50 debt service coverage ratio, a 9.0 percent interest rate, and a 25-year amortization period. Since this computation is conservative and it would be difficult to calculate project value, our model does not take loan-to-value constraints into consideration. This conservative computation also precludes any additional allowances in our model for transaction costs related to refinancing.

Testing the Lifecycle Cost Adjustment Methodology

To test the effects of the lifecycle cost adjustment, we applied it to a convenience sample of 269 properties located in 35 states and the District of Columbia.[16] The data on properties in the sample came from nine non-profit affordable housing developers (103 properties) and two syndicators of low-income housing tax credits (LIHTCs) (166 properties). They included 125 acquisition-rehab properties and 144 new construction properties. More information on the sample can be found in Appendix B.

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[15] Based on discussions with practitioners, we assumed that developers and lenders and investors would require replacement of a building system at the time of rehab, rather than go forward with an acquisition-rehab knowing that a major building system would require replacement five years or less into the property's life.

[16] Our analysis of the factors influencing the lifecycle cost adjustment and the effects of varying specific methodological assumptions was conducted using an extract of data on 269 properties compiled for purposes of comparing two methods of producing affordable multifamily rental housing: new construction and acquisition–rehab. Subsequent to conducting this analysis, we collected additional information on the sample properties and used the expanded dataset in our final analysis of the relative costs of these two production methods. Since the relationships documented in this technical paper are unlikely to be materially impacted by the additional information included in the expanded dataset, we have not re-run the analysis using the expanded dataset.

We examined how many properties in the sample required a lifecycle cost adjustment, the size of the adjustment, and the effect on overall ATDC. Overall, we found that 127 of the 269 sample properties (47 percent) were not able to meet their capital needs over a 50-year period and therefore required a lifecycle cost adjustment (see Table 2). The median lifecycle cost adjustment for these 127 properties was $7,453 per unit, while the median ATDC per unit for all properties was $140,104. The results for acquisition-rehab and new construction projects are presented in Table 2.

Note: In all of the tables in this paper, AR refers to acquisition-rehab and NC refers to new construction.

Table 2: Median Initial and Adjusted Total Development Costs Per Unit

	All	AR	NC
Number of Projects	269	125	144
Initial Total Development Costs Per Unit	$136,235	$120,884	$159,022
Number/Percent Requiring a Lifecycle Cost Adjustment	127 (47%)	56 (45%)	71 (49%)
Median Lifecycle Cost Adjustment Per Unit (for properties requiring an adjustment)	$7,453	$6,959	$8,453
Median Adjusted Total Development Costs Per Unit	$140,104	$122,765	$161,737

While there was an apparent difference in the median lifecycle cost adjustments for new construction and acquisition-rehab properties, as reflected in Table 2, we did not find a statistically significant difference. This was not surprising to us since the typical acquisition-rehab property in our sample underwent very significant rehab and thus was “almost like new” when completed. The annual reserve deposit amounts of new construction and acquisition-rehab properties in our sample were also similar.

Sensitivity Analysis

We applied alternative assumptions in the model and tested the impact of these changes on (a) the number and percentage of projects requiring a lifecycle cost adjustment over the analysis period and (b) the median lifecycle cost adjustment for properties that required one. This section summarizes our findings. For each alternative assumption, we present the baseline and alternative assumption in brief. We then describe the alternative assumption in more detail and compare the effect of changing from the baseline to the alternative assumption.

Analysis Period Assumptions

Baseline Assumption: 50-year analysis period

Alternative Assumptions: 40-, 30-, or 20-year analysis periods

In our baseline analysis with a 50-year analysis period, approximately 47 percent of all properties required a lifecycle cost adjustment to fully meet their capital needs (as shown in Table 2 on page 9). When the analysis period was shortened to 20 years, fewer properties required a lifecycle cost adjustment (see Table 3), due at least in part to the fact that some of the most expensive systems were not replaced until 25 or 30 years after project completion. When the analysis assumed a 30- or 40-year period, there was little to no effect on the number of properties requiring an adjustment compared with the baseline assumption of 50 years. In fact, only one property had a lifecycle cost adjustment in the 50-year analysis but not in the 30- or 40-year analyses.

While the number of properties requiring an adjustment was not substantially changed under a 30- or 40-year period, the magnitude of the adjustment was sensitive to the length of the analysis period. The relative difference between the median lifecycle cost adjustment for acquisition-rehab and new construction properties shrank somewhat over longer time periods. The median new construction adjustment was 42 percent larger than the acquisition-rehab adjustment in the 30-year analysis, but only 21 percent larger in the baseline 50-year analysis.

Table 3: Alternate Analysis Periods

	Percent Requiring a Lifecycle Cost Adjustment		Median Lifecycle Cost Adjustment Per Unit (excluding zeroes)		
	AR	NC	AR	NC	NC compared to AR
20-Year	14%	21%	$4,391	$1,547	-65%
30-Year	45%	49%	$4,771	$6,760	+42%
40-Year	45%	49%	$5,556	$7,123	+28%
50-Year	45%	49%	$6,959	$8,453	+21%

Cash Flow and Refinancing Assumptions

Baseline Assumption: Cash flow and refinancing proceeds can be used to cure a replacement reserve deficit.

Alternative Assumption: Cash flow and refinancing proceeds are not redirected to fund necessary capital needs.

In standard industry practice, properties whose replacement reserve funding is not adequate to address long-term capital needs follow two primary strategies (our baseline assumption) in order to overcome what otherwise would be reserve deficits:

- Use the property's cash flow directly, either to pay for capital needs or to make additional deposits to the replacement reserve. We refer to this as the "cash flow" strategy. The effectiveness of this strategy depends on the level of cash flow generated by the property.
- Use the property's cash flow indirectly, by refinancing project debt to raise additional capital that can be used to pay for capital needs. We refer to this as the "refinancing" strategy. The effectiveness of this strategy is a joint function of the level of cash flow and the project's existing mortgage debt. If the project's debt has a high interest rate, a low unpaid balance, or both, refinancing could be superior to simply using project cash flow directly.

If neither the cash flow nor the refinancing strategy is sufficient, an owner typically must choose one of the following: invest additional cash in the project; default on the hard debt[17]; or (if the value of the project is sufficient) sell the project. Our model calculates the minimum lifecycle cost adjustment to the initial replacement reserves that would be needed in order to avoid the reserve deficit situation that forces the owner into this generally undesirable set of choices.

Our impression of industry asset management practice supports the baseline assumption that owners would refinance or redirect cash flow into the reserves in order to avoid a reserve deficit. The alternative (owners do not use cash flow or refinancing proceeds for the replacement reserve) requires one to assume that owners will under-maintain the property in order to utilize cash flow and refinancing proceeds for other purposes. Although some owners might follow such a strategy in a mild way over a short period of time, to follow it in any more extreme form would violate typical loan covenants and regulatory requirements that require adequate maintenance.

In this alternative scenario (cash flow and refinancing are not available to supplement the reserve), all but one acquisition-rehab and all but 17 new construction properties in our sample would have required a lifecycle cost adjustment. For properties that required a lifecycle cost adjustment when neither cash flow nor refinancing were used, the median per-unit lifecycle cost adjustment estimate was roughly $11,000 higher than the baseline scenario (see Table 4).

Table 4: Alternate Treatment of Cash Flow/Refinancing Proceeds

	AR		NC	
	Baseline	**No Cash Flow/Refi**	**Baseline**	**No Cash Flow/Refi**
Number/Percent Requiring a Lifecycle Cost Adjustment	56 (45%)	124 (99%)	71 (49%)	127 (88%)
Median Lifecycle Cost Adjustment Per Unit (excl zeroes)	$6,959	$18,745	$8,453	$19,641

[17] In the industry and in this paper, the term "hard debt" refers to mortgage debt with fixed monthly payments that must be made without regard to the project's available cash flow.

Capital Needs Accrual Assumption

Baseline Assumption: Calculate capital needs on a "cash basis."

Alternative Assumption: Calculate capital needs on an "accrual basis."

The baseline assumption calculated capital needs on a cash basis, including only the systems that would be replaced during the analysis period. An alternative was to calculate capital needs on an accrual basis and include the proportional cost of the next replacement based on the share of a system's useful life already consumed at the end of the analysis period. For example, if the analysis period ended five years into the 15-year useful life of an air conditioner, calculating on an accrual basis would include 1/3 of its replacement cost at the end of the analysis.

In the sample dataset, using an accrued capital needs approach did not materially affect which properties required a lifecycle cost adjustment during a 50-year analysis period (see Table 5). However, it did affect the size of the lifecycle cost adjustment significantly; this was to be expected since the proportional costs of the next round of each building system's replacement were included in the costs. We utilized the cash basis on the theory that it most accurately reflected the actual costs of operating the property over the analysis period.

Table 5: Using an Accrual Basis to Estimate Capital Needs

	AR		NC	
	Baseline	**Accrual Basis**	**Baseline**	**Accrual Basis**
Lifecycle Cost Adjustment > $0	56 (45%)	60 (48%)	71 (49%)	79 (55%)
Median Lifecycle Cost Adjustment Per Unit (excl zeroes)	$6,959	$16,867	$8,453	$20,279

Initial Reserves Assumption

Baseline Assumption: Use only replacement reserves to cover capital needs, ignoring other initial reserves.

Alternative Assumption: Use other initial reserves (e.g., operating reserves) to pay for capital costs if the replacement reserve is depleted.

Some properties included initial reserve balances other than the replacement reserve. The most common example of this was an operating reserve, generally designed to guard against the risk of cash flow deficits during lease-up and in the early years of project operation. Our baseline assumption was that the replacement reserve was the only reserve fund used to pay for capital needs over the course of the analysis period. An alternative assumption was that other initial reserve funds such as operating reserves could be used as a backstop to supplement the replacement reserve.

In the sample dataset, using other initial reserves to cover capital expenditures lowered the median lifecycle cost adjustment per unit for both acquisition-rehab and new construction properties (see Table 6). Using other initial reserves, the median lifecycle cost adjustment for acquisition-rehab and new construction properties with an adjustment was roughly comparable.

Table 6: Using Other Initial Reserves to Cover Capital Needs

	AR		NC	
	Baseline	**Other Initial Reserves**	**Baseline**	**Other Initial Reserves**
Lifecycle Cost Adjustment > $0	56 (45%)	58 (46%)	71 (49%)	75 (52%)
Median Lifecycle Cost Adjustment Per Unit (excl zeroes)	$6,959	$6,207	$8,453	$6,338

Contrary to expectations, more properties required a lifecycle cost adjustment when other initial reserves were made available to cover capital needs than under the baseline assumption. In a similar fashion, the size of the lifecycle cost adjustment increased for 30 properties when other initial reserves were used. This occurred because two opposing effects were in play: (1) delaying the first reserve deficit and (2) delaying the first use of cash flow or refinancing.

Using other initial reserves delayed the first reserve deficit, as expected, which acted to reduce the lifecycle cost adjustment. However, this scenario also delayed the first use of cash flow/refinancing, which acted in the opposite direction because the delay resulted in less total cash flow that could be applied towards capital needs. Thus, for about one in seven sample properties, tapping these other initial reserves appeared to have had a negative impact on their ability to self-finance capital needs.

Replacement Reserve Deficits Before the End of the Analysis Period

Baseline Assumption: A replacement reserve deficit in any year can contribute toward the lifecycle cost adjustment.

Alternative Assumption: Only a reserve deficit at the end of the analysis period can contribute toward the lifecycle cost adjustment.

If we only calculated a lifecycle cost adjustment when a reserve deficit occurred in the final year of the analysis, the number of properties in our sample requiring a lifecycle cost adjustment was reduced by 40 (evenly divided between new construction and acquisition-rehab properties) (see Table 7). This suggested that 40 properties experienced a reserve deficit throughout the course of the analysis period that was remedied by year 50.

Table 7: Basing the Lifecycle Cost Adjustment on Only the Year 50 Deficit				
	AR		NC	
	Baseline	Year 50 Deficit	Baseline	Year 50 Deficit
Lifecycle Cost Adjustment > $0	56 (45%)	36 (29%)	71 (49%)	51 (35%)
Median Lifecycle Cost Adjustment Per Unit (excl zeroes)	$6,959	$9,600	$8,453	$11,792

Although fewer properties required a lifecycle cost adjustment under the alternative assumption, the median value of the lifecycle cost adjustment was higher because the 20 acquisition-rehab properties and 20 new construction properties that no longer required an adjustment had relatively small lifecycle cost adjustments, thereby increasing the median values.

Finally, it is worth noting that for most of the 36 acquisition-rehab and 51 new construction properties with a lifecycle cost adjustment under both assumptions, there was no difference in the estimated adjustment, suggesting that typically the baseline scenario also used the end-year deficit to calculate the lifecycle cost adjustment. Where there was a difference in the adjustment, it was higher under the baseline scenario because earlier reserve deficits were only used if they resulted in a larger adjustment compared with the last year of the analysis.

Acquisition-Rehab Replacement Assumptions

Baseline Assumption: For acquisition-rehab projects, building systems that would require replacement within the first five years of project completion were assumed, instead, to have been replaced two years prior to the year of rehab.

Alternative Assumption: For building systems that were not replaced during the process of acquisition and rehabilitation, system replacements were derived solely from the year of the project's original construction and that system's effective useful life without regard to how soon after project completion the first such replacement would occur.

Our impressions of industry practice support the baseline assumption that system replacements do not occur in the first five years after project completion. When we assumed differently and allowed system replacements in the first five years, a net of three sample properties were added to the number requiring a lifecycle cost adjustment. This figure, however, did not show the full effect of the alternative assumption. The lifecycle cost adjustment increased for 29 acquisition-rehab properties[18]: six that did not require a lifecycle cost adjustment under the baseline methodology and 23 that saw their adjustment increase over the baseline. However, for another 29 properties, the lifecycle cost adjustment decreased relative to the baseline and actually disappeared altogether for three of them.

[18] There is no impact on new construction properties because all systems are new, and no systems have an effective useful life shorter than seven years.

For these 29 properties, allowing early system replacements created an earlier deficit than under the baseline scenario. As a result, the model moved additional years of cash flow to the replacement reserve, which in turn lowered the lifecycle cost adjustment. Because changing this assumption resulted in a comparable number of properties with higher and lower lifecycle cost adjustments, the difference in the median adjustment was negligible (see Table 8).

Table 8: Allowing Early System Replacements

	AR	
	Baseline	**Early Replacements**
Lifecycle Cost Adjustment > $0	56 (45%)	59 (47%)
Median Lifecycle Cost Adjustment Per Unit (excl zeroes)	$6,959	$6,398

Applying the Lifecycle Cost Methodology to Individual Properties

This paper has described the lifecycle cost methodology in relation to a comparison of the costs of acquisition-rehab and new construction, but the methodology can also provide a window into the long-term viability of an individual affordable multifamily rental property.

To allow developers, lenders, syndicators, regulators, and others to use and evaluate this new method of estimating the capital costs associated with developing and maintaining a property over a full lifecycle, we have used the model as the underpinning for an online Lifecycle Cost Modeling Tool, available at www.housingpolicy.org/lcycle. Users of the tool can input a property's financial data, adjust our baseline assumptions, and obtain an estimate of whether the property is likely to fund its long-term capital needs with the planned replacement reserves, by adding funds from cash flow, or by refinancing. The output of the tool is a graph that allows users to see easily when during the 50-year life cycle reserve funding problems occur, the seriousness of each problem, and (in the cash flow and refinancing scenarios) how much of cash flow or refinancing resources might be needed to meet long-term capital needs, as opposed to putting them toward other uses such as paying distributions to investors.

Appendix A: Computing the Lifecycle Cost Adjustment

For properties with at least one year of negative ending reserve balances after using either the cash flow or refinancing strategy to apply additional resources to meet capital needs, a trial lifecycle cost adjustment is calculated for each year in which the ending reserve balance is negative.

The lifecycle cost adjustment represents the minimum corrective initial deposit to the replacement reserve that would be needed in order to avoid the reserve deficit in the year that is being analyzed. The model calculates a trial lifecycle cost adjustment by dividing the negative reserve balance by an interest factor as described below:

- For deficits that occur on or after year 30 in the baseline 50-year analysis period, the model computes the interest factor as follows: (a) the five percent long-term treasury rate for 30 years $(1+5\%)^{30}=4.32$ MULTIPLIED BY (b) the 1.5 percent passbook factor for the remaining years (for example, for a deficit occurring in year 50, the passbook factor would be computed for 50-30 = 20 years and would be: $(1+1.5\%)^{20} = 1.34$); and the total interest factor would be 4.32 PLUS 1.34 EQUALS 5.82.

- For deficits that occur on or after year 20 in shorter analysis periods, the model computes the interest factor as follows (a) the five percent long-term treasury rate for 20 years $(1+5\%)^{20}=2.65$ MULTIPLIED BY (b) the passbook factor for the remaining years (for example, for a deficit occurring in year 40, the passbook factor would be computed for 40-20 = 20 years and would be: $(1+1.5\%)^{20} = 1.34$); and the total interest factor would be 2.65 PLUS 1.34 EQUALS 3.56.

- For deficits that occur prior to year 30 in the baseline analysis or prior to year 20 in the alternative analysis, the interest factor is computed based solely on the 1.5 percent passbook interest rate. For example, for a deficit occurring in year 15, the interest factor would be: $(1+1.5\%)^{15} = 1.25$.

The financial theory underpinning the additional up-front reserve deposit holds that the additional deposit would be invested in 30-year Treasuries (in the baseline approach; 20-year Treasuries if analysis periods are shorter than 50 years). At maturity (year 30 in the baseline approach, year 20 alternatively), the funds would be reinvested at passbook rates. Thus, the interest factor for the baseline 50-year analysis period uses 30 years at the 30-year Treasury Note rate plus 20 years at passbook rates.

For a property with reserve deficits, the process described above results in one trial lifecycle cost adjustment for each year in which a deficit occurs. Each trial lifecycle cost adjustment is calculated as the deficit (expressed as a positive amount) multiplied by the interest factor. For example, for a property with deficits only in years 18, 24, and 40 there would be three trial lifecycle cost adjustments, one for each of those three years. Continuing the example, we say that these were $1,500 per unit (year 18), $2,500 per unit (year 24), and $7,500 per unit (year 40). The final lifecycle cost adjustment is the largest of the trial lifecycle cost adjustments for years in which the ending reserve balance is negative. The final lifecycle cost adjustment would be $7,500 per unit.

Typically, projects having reserve deficits in any year also have a reserve deficit in the final year of the analysis period. That final year deficit is the largest deficit and requires the largest trial lifecycle cost adjustment.

Appendix B: The Sample Properties

As the paper describes, we tested the lifecycle cost adjustment methodology using a convenience sample of 269 properties. The sample included 125 acquisition-rehab properties and 144 new construction properties. The dates of construction or rehab for the properties in the sample ranged from 1999 to 2010, with approximately half (48 percent) constructed or rehabbed between 2005 and 2007.

The states and Census Regions included in the sample represented significant geographic diversity. The sample included properties from 35 states and the District of Columbia. The median number of properties in any state was five. The states with the largest representation in the sample were: California – 49; Virginia – 28; Ohio – 26; Illinois – 18; Washington – 18; New York – 11; Colorado – 10; and Maryland – 10.

Financial Characteristics

The overwhelming majority of properties in our sample received some form of LIHTC—mainly in the form of 9 percent credits. Just 20 properties in the sample had no LIHTC financing.

In other aspects of project financing, there were significant differences between the acquisition-rehab and new construction projects in our sample. As illustrated in Table B1, the acquisition-rehab projects were more reliant on hard debt, and new construction projects were more likely to utilize soft debt.[19] Both types relied heavily on LIHTC equity, but new construction projects relied on it more so.

Table B1: Average Financing by Source

	All	AR	NC
% LIHTC Equity	42%	38%	45%
% Hard Debt	22%	31%	15%
% Soft Debt	31%	24%	36%
% Other	5%	7%	4%
Total	100%	100%	100%

Nearly half (45 percent) of the sample properties received an initial deposit to their replacement reserves. Initial reserve deposits were much more common in acquisition-rehab properties (73 percent)

[19] The term "hard debt" refers to mortgage debt with monthly payments that must be made without regard to project cash flow; "soft debt" refers to other mortgage debt in which payments may be contingent on cash flow, deferred, or both.

than in new construction (21 percent). The median initial reserve deposit was $1,124 per unit, and the median annual deposit to the replacement reserve was $293 per unit.

Extent of Rehabilitation

For most of the acquisition-rehab properties in our sample, the level of rehab was significant. Of the 21 building systems that we tracked, 14 or more were replaced during acquisition-rehab in at least 74 percent of the acquisition-rehab properties. The only systems that were excluded from the majority of the rehabs were: sealing and striping the parking lot (completed in 34 percent); resurfacing asphalt (34 percent); replacing exterior wood doors and frames (27 percent); replacing exterior wood stairs (18 percent); and replacing balconies (18 percent).

Study Team

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Compass Group (Charlie Wilkins and Anker Heegaard)
Summit Consulting (Albert Lee and Amy Deora)

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About the Authors

The **Center for Housing Policy** is the research affiliate of the **National Housing Conference** (NHC) and specializes in developing solutions through research. In partnership with NHC members, the Center works to broaden understanding of the nation’s housing challenges and to examine the impact of policies and programs developed to address these needs. Combining research and practical, real-world expertise, the Center helps to develop effective policy solutions at the national, state and local levels that increase the availability of affordable homes.

The **Compass Group, LLC**, provides direct advisory services related to affordable housing finance, asset management, and public policy. Compass has specialized expertise in the design of funding mechanisms, green building issues, multifamily data, federal housing programs and their regulatory requirements, and disaster recovery issues. Their perspective contributes a balanced understanding of financial, operational and public policy considerations that drive affordable housing, and of the ways they interact.

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