GREEN BUILDING STRATEGIES
COST ANALYSIS
CITY OF ALEXANDRIA

FINAL TECHNICAL REPORT

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1 EXECUTIVE SUMMARY

1.1 OVERVIEW

This report and analysis is intended to provide the City of Alexandria (City), and the City's Green Building Policy Task Force, with a general understanding of the cost impacts of proposed updates to its Green Building Policy. The report includes cost impacts for City buildings, private developments, and existing City policies. The Green Building Policy update has been set forth in the recently updated Environmental Action Plan (EAP), and specific strategies examined have been prioritized by the Green Building Policy Task Force.

The analysis estimates the incremental cost differences between levels of LEED v4 certification as measured from the baseline and also estimates cost differences in the specific areas of Energy/GHG, water and stormwater. The appendices include the Green Building Cost Matrix tool, which consolidates the findings from this research in one place. This matrix is designed to be used by stakeholders including City staff, the Green Building Task Force, the Environmental Policy Commission, and other stakeholders to assist with evaluating and prioritizing green building policy updates under consideration. The baseline for the Cost Matrix tool is LEED 2009 NC Silver.

1.2 CONCLUSIONS AND RECOMMENDATIONS

Green buildings can provide significant value and benefits at little to no additional construction costs, but the benefits and costs can vary significantly based on geographic, project specific, and logistical factors. On the one hand, green building requirements can result in significant cost increases on a project, on the other, green building strategies have also resulted in first cost savings and significant returns over time. Our study shows that updating the City's current green building requirements to meet the LEED v4 standard has the potential to have little to no cost impact for new development projects under the right circumstances.

We recommend that, at a minimum, the City updates the green building requirements to meet the LEED v4 standard and strongly considers increasing the LEED certification target at least one level. Additionally, there are several specific green building strategies that have modest additional costs and should be considered. Finally, it is strongly recommended that the City support the integrative design process through incentives and technical support to help project teams effectively manage green building costs.

Incremental costs associated with increasing certification standards can range from -1.5% to +12% depending on the scenario - As demonstrated in the Green Building Cost Strategies Matrix found in the appendix, the green building strategies evaluated range from a 1.5% first cost savings to 12.0% cost increase over the baseline of LEED 2009 NC Silver. The study and matrix show cost ranges for all of the project types and strategies evaluated because many of the variables that impact first costs can be managed by the design and construction team.

- Cost Impacts on the Financial Feasibility of Affordable Housing - Given the differences in financing structure between market-rate residential and affordable housing product, we recommend that the updated policy allow for flexibility to review affordable housing new construction and renovation projects on a case-by-case basis to ensure financial feasibility, including an affordable housing component in a mixed-use format.

Experienced, integrated project teams can achieve the lower end of the cost range - Our research and experience confirms that experienced and integrated project teams are more likely to implement green building strategies at the low end of the cost ranges provided. Following the integrative design process (also called integrated design process or integrated project delivery[1]) combines the team early in the design process to collaborate across disciplines, harnesses the insights of all participants to increase value to the owner, reduces wasted time and materials, and maximizes resource efficiency throughout the design and construction periods.

To embed green building principles into the project, teams should focus on building performance outcomes and increased project value to owner, users, operators, and society. This may begin with strategic conversations with the owner to determine which green building practices best fit into the objectives of the project to meet the targets set forth by the City's Green Building Policy. Next, a team could include qualitative or quantitative goals included in the building program accounts for emissions, energy, water,

[1] Integrated Project Delivery: A Guide, American Institute of Architects, 2007

waste, occupant health, etc. The crucial conclusion is that green building strategies are not considered a cost or expense to be minimized, but an investment in the value of the building. Performance-based procurement, as recommended in the Integral Group report, is a logical approach for the City to benefit from these practices and deliver public buildings with higher green building standards in a cost-efficient manner.

On average, energy and water efficiency strategies tend to have different cost timing profiles - In the cost analysis to developers we found that water efficiency strategies have the lowest up-front costs to implement, but also the lowest operational cost savings. In contrast, energy upgrades and ongoing performance verification of energy systems have the highest up-front costs and the largest potential operational savings. The distinction between up-front and operational cost savings is important in a market where properties are often sold after development to be operated by a different entity. The developer and operator are likely to have conflicting priorities in which green building strategies are implemented, and developer preferences for one approach over another may not align with the City's goals related to energy and water usage, and industry preferences may be reflected in the aggregate, total benefit perspective.

An increased standard for public buildings has the potential to increase City capital costs by anywhere from $5 to $35 million over the next ten years, depending on the policy change – Based on a preliminary review of the City's most recent 10-year Capital Improvement Program (CIP), applying a broad range of potential green building cost increases of 1.1 to 8.3%[2] on investments in new buildings and major renovations suggests an estimated additional $5 to $35 million in capital costs above what is planned for in the CIP over the next ten years. However, this estimate does not include the resulting annual operating cost savings from reduced energy and water usage. Payback period can range significantly depending on the strategies implemented. There are examples of payback periods as short in duration as 5 to 7 years ranging to as high as 25 to 30 years, depending on the ratio of upfront cost to ongoing benefit. In a scenario where a shift to LEED Gold led to increased capital costs of 1.1% to 3.2% or $5 to $13 million, and ongoing utility cost reductions were approximately 30%, these cost savings could have a payback period ranging from 7 to 12 years[3].

There are a wide variety of incentives that can be used by the City to increase the use of green building – Available incentives range from structural options such as density bonuses, FAR exclusions for passive design elements, and expedited permitting, to financial incentives such as tax credits and abatements, and fee reductions/waivers. Such mechanisms have been implemented by other local jurisdictions in the region and elsewhere to varying degrees of success. Structural incentives require little to no monetary cost to the City while financial incentives require monetary costs to the City in proportion to the amount of incentive. The range of incentive options have been evaluated in the context of Alexandria's current planning and zoning policies and processes. Expedited building permitting is not a viable option given the City's already brief building permitting timeline, and any use of a density bonus for green building requires the City to ensure that it will not hinder participation in its existing density bonus for affordable housing.

A green building density bonus is an effective mechanism but has the potential to impact participation in the existing affordable housing bonus density – Additional density is one of the most appealing incentives to developers due to the resulting inherent increase in property value it provides. Findings from other areas that offer both types of bonuses indicates that the two can coexist if they combine to meet the parcel's maximum FAR allowed. However, if only one bonus is sufficient to achieve maximum allowable density, this will force a choice between green building and affordable housing. There are too many variables at the project level to generalize which option may be more valuable from the developer's perspective, but if zoning conditions result in choosing between one of the two options, there will be an impact to the existing affordable housing bonus density program.

For existing buildings and projects not subject to plan review, smaller scale incentives such as tax credits or fee reductions/waivers are most effective – Since the Commonwealth of Virginia is a Dillon Rule state, the City is currently unable to require green building practices beyond those of the building code for existing buildings and smaller developments not subject to the Development Site Plan (DSP)/Development Special Use Permit (DSUP) review process. Given that the City does not have the leverage afforded by the DSP/DSUP review process in these circumstances, limited financial incentives may be effective in fostering green building practices without having a large negative fiscal impact., In the event that the City gains the authority, for smaller projects not subject to site plan review, applying the Green Building Policy based on a density threshold could ensure that smaller new construction projects are meeting the City's goals. For existing privately-owned buildings, we concur with the recommendations suggested in the Integral Group report, including challenge programs, educational outreach, implementation of C-PACE, and others.

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[2] Reflects the low end of the cost increase range for LEED Gold and high end of the range for net-zero energy

[3] Payback for the 30% energy cost savings assumed in the LEED Gold mid-cost scenario

2 BACKGROUND

2.1 GREEN BUILDING IN ALEXANDRIA

In 2009, the City of Alexandria adopted a Green Building Policy which established green building standards for development projects as part of implementation of the City's Eco City Charter. For Fiscal Year 2019, Alexandria City Council prioritized an update to the Green Building Policy and established a Task Force to provide guidance to staff. Subsequently, the City sought outside technical expertise to support this work.

The Department of Planning and Zoning (P&Z) requested a cost analysis of the green building strategies listed below. The analysis is expected to evaluate the cost to implement each strategy and the potential impact on other City incentive programs.

2.1.1 GREEN BUILDING STRATEGIES

The following green building strategies were discussed and agreed upon by the City's Green Building Policy Update Task Force (the "Task Force") at its initial group meeting in early November of 2018. This analysis provided in this report will evaluate and justify the costs associated with these strategies:

- Strategy A+D: Increase LEED or equivalent third-party green building certification standards for private development and prioritize specific green building elements in private development projects.
- Strategy B: Establish a separate green building standard for new public development, at a level more ambitious than required for private development and evaluating the feasibility of a net zero standard for new public development, including schools.
- Strategy C: Establish incentives for private development participation in green building certifications.
- Strategy E: Existing Private Buildings (Commercial, Multifamily, and Single Family): Introduce mandatory and/or voluntary green building practices for existing buildings (including historic) and for small buildings not subject to site plan review.

3 APPROACH AND METHODS

3.1 METHODOLOGY

WSP conducted research on the costs of various green building strategies to estimate the cost implications of changes to the City's Green Building Policy. The results of this research and analysis is summarized in the Green Building Cost Matrix, which is a tool designed to facilitate evaluation and prioritization by the Task Force based on each strategy's relative impact, cost, and ease of implementation.

The Green Building Cost Matrix is accompanied by a full report detailing the matrix results, the impact of applying varying green building certification levels on the financial feasibility of three case study developments in Alexandria, and the viability of various green building incentives.

3.1.1 GREEN BUILDING COST MATRIX

GREEN BUILDING STRATEGIES

Based on WSP's experience with cities, municipalities, school systems, and other planning entities, we have identified common and less common (yet impactful) strategies for green building in the categories of Energy/GHG, Water, and Stormwater which are target areas identified in the City's Environmental Action Plan (EAP) for green buildings in Alexandria. This list of specific green building strategies includes LEED-specific strategies along with other strategies that align with the City's Environmental Action Plan.

PROJECT TYPES

To perform an analysis of feasibility, cost, and priority WSP established a series of project types based on projects from previous cost analysis (pro forma models), city staff input, and our own experience. The parameters for each project type regarding size, location type, cost per square foot, etc. is documented in the methodology. The list of project types is shown below in Table 1.

Table 1: Land Uses Analyzed

New Private Development	· Office (OFF) · Multifamily (MF) · Small Buildings (SML)
Existing Private Development	· Commercial (COM) · Multifamily (MF) · Single-family residential (SF)
New Public Buildings	· Schools (SCH) · Fire/Police (FIRE)
Existing Public Buildings	· Schools (SCH) · Fire/Police (FIRE)

COST ANALYSIS

Using published research, case studies, and differential cost studies[4], WSP provided cost analysis for each green building strategy in the areas of Energy/GHG, Water and Stormwater. Using the LEED rating system certification as the standard, the costs also show differences between different levels of green building certification over a baseline of LEED 2009 NC Silver.[5] Below is an outline of what is included in the cost matrix.

Table 2: Summary of Cost Matrix Certifications and Strategies by Type

CERTIFICATIONS	ENERGY/GHG	WATER	STORMWATER
· LEED v4 Certified · LEED v4 Silver · LEED v4 Gold · LEED v4 Platinum · Net-Zero Energy	· Improved Building Envelope · Efficient Building Systems · Integrated Building Controls · Commissioning (Fundamental & Enhanced) · Ongoing Performance/M&V · Energy Use Intensity (EUI)	· Outdoor Water Savings · Indoor Water Savings · Process Water Savings · Commissioning · Ongoing Performance / M&V · Water Metering & Performance · Water Use Intensity (WUI)	· Green Infrastructure (ground) · Green Infrastructure (roof) · Rainwater Collection

[4] A summary of the cost studies referenced are included in Appendix 5.3
[5] The baseline assumes a building achieving LEED 2009 NC Silver under the 2012 Virginia Uniform Statewide Building Code

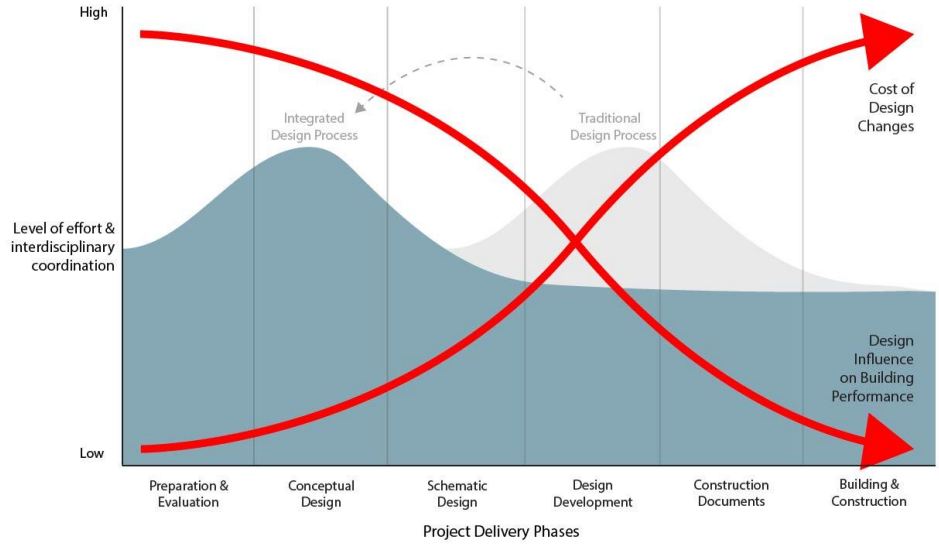
4 FINDINGS AND ANALYSIS

4.1 GREEN BUILDING COSTS

The costs and benefits of green building strategies depends on a wide array of geographic, temporal, and logistical factors. On the one hand, this can result in enormous costs to the project, on the other, green building strategies may provide first cost savings and returns over time. As demonstrated in the Green Building Cost Strategies Matrix, some green building strategies could range from almost 5% savings to over 10% costs. While some of the factors that determine this range are out of the project team's direct control, there are significant opportunities for project teams to increase the probability of savings and avoid the possibility of costs.

Integrating the project team: Following the integrative design process (IDP), also called integrated design process or integrated project delivery[6], combines the team early in the design process to collaborate across disciplines, harness the insights of all participants to increase value to the owner, reduce wasted time and materials, and maximize resource efficiency throughout the design and construction periods. For example, occupants and building owners may be involved to contribute to the vision of how the space will be used. Architects and engineers can generate spaces and systems that maximize energy and water savings while optimizing for occupant experience and health. Contractors can provide estimates and feedback before the design is finalized to reduce to disjunction between the handoff from design to construction. Rather than value engineering, the project team can determine a target value or target which promotes designing to a detailed estimate and avoiding the need to value engineer later on. Additionally, IDP can reduce design time by avoiding unnecessary design draft iterations and shorten project delivery by providing time to order materials early. Most green building strategies must be integrated into the design early to be effective, and their cost increases as the design and construction process proceeds. When teams do not begin their planning and conversations early but attempt to employ green building strategies, results are mixed. A David Langdon report comparing green building projects across the country and across certification levels and found teams that tried to add green building strategies on after the design or construction projects have less success at higher costs.[7] Therefore, whatever the context, following an integrative design process will return dividends upon completion of the building.

Figure 1: Cost and Impact of Green Building Strategies



[6] Integrated Project Delivery: A Guide, American Institute of Architects, 2007

[7] Costs of Green Revisited: Re-examining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption, Davis Langdon, 2007.

Green building as a program issue, not an added requirement: To embed green building principles into the project, teams should focus on building performance outcomes and increases project value to owner, users, operators, and society. This may begin with strategic conversations with the owner to determine which green building practices best fit into the objectives of the project. Next, a team could include qualitative or quantitative goals included in the building program accounts for emissions, energy, water, waste, occupant health, etc. The crucial conclusion is that green building strategies are considered a cost or expense to be minimized, but an investment in the value of the building.

4.2 GREEN BUILDING COSTS FOR PRIVATE DEVELOPMENT

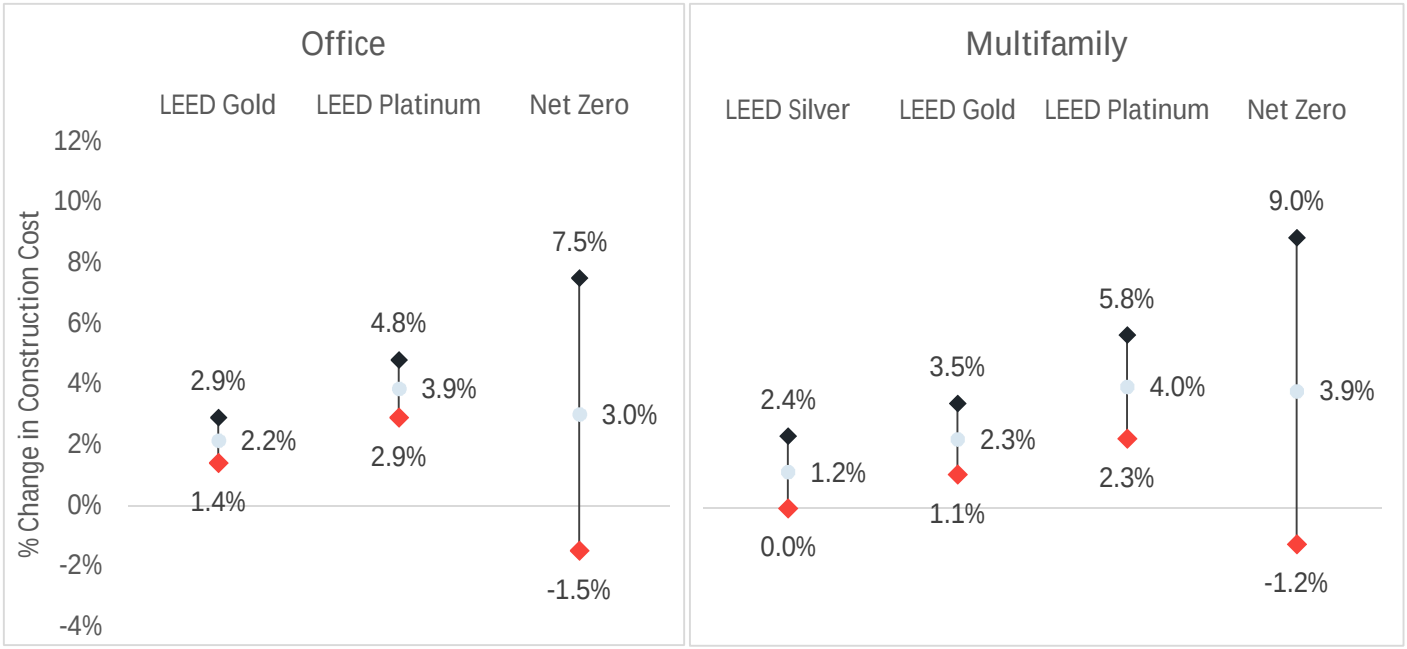
The Green Building Strategies Cost Matrix provides cost ranges for each applicable strategy and building type associated with private developments. The cost ranges reflect projects at the 20th and 80th percentile of the range and not the highest and lowest ends of the cost spectrum.

Soft Costs - Our research confirms that investments in experience and well-integrated project teams can lead to significant construction cost savings. Confirming project team qualifications, experience working together, and a proven track record of high-performance projects will help manage risk and cost. This approach may increase soft costs early in the development process but can be more than offset by limiting construction cost overruns.

Construction Costs – Experienced contractors are critical to the success of green building projects. Cost estimates for green building strategies tend to be significantly higher when provided by contractors and subcontractors with little experience on LEED and green building projects. This includes contractors that have only worked on one or two green building projects. Procure a construction team that has demonstrated experience and dedicated staff to manage the LEED and sustainability efforts.

Figure 2 shows the range and midpoint of potential construction cost changes by land use and level of certification for new office and multifamily developments.

Figure 2: Range of Green Building Incremental Percentage Costs for New Office (left) and Multifamily (right) Buildings[8]



[8] See appendices 5.1-5.3 for more detail

Based on our cost research, increasing from the baseline to LEED Gold results in a construction cost increase ranging from 0.5% to 2% for office buildings and 0.4% to 2.4% for multifamily residential buildings. Increasing from the baseline to LEED Platinum increases office construction costs by a range of 1.5% to 5% and multifamily residential costs by 1.2% to 6%. Achieving net zero energy has the broadest range of construction cost impacts, from cost savings as low as 2% to cost increases as high as almost 10%. Net construction cost savings for net zero energy buildings can take place in scenarios where achieving net zero energy is the primary goal, versus achieving a specific level of LEED certification, which can require several different strategies to achieve.

4.3 GREEN BUILDING COSTS FOR THE CITY

The costs of implementing the various green building strategies from the City's perspective fall into three general categories: 1) operating costs associated with administering and overseeing new policies, such as staffing and resources, 2) capital costs associated with higher thresholds of green building for public / City-owned buildings, and 3) costs associated with incentives offered for green building.

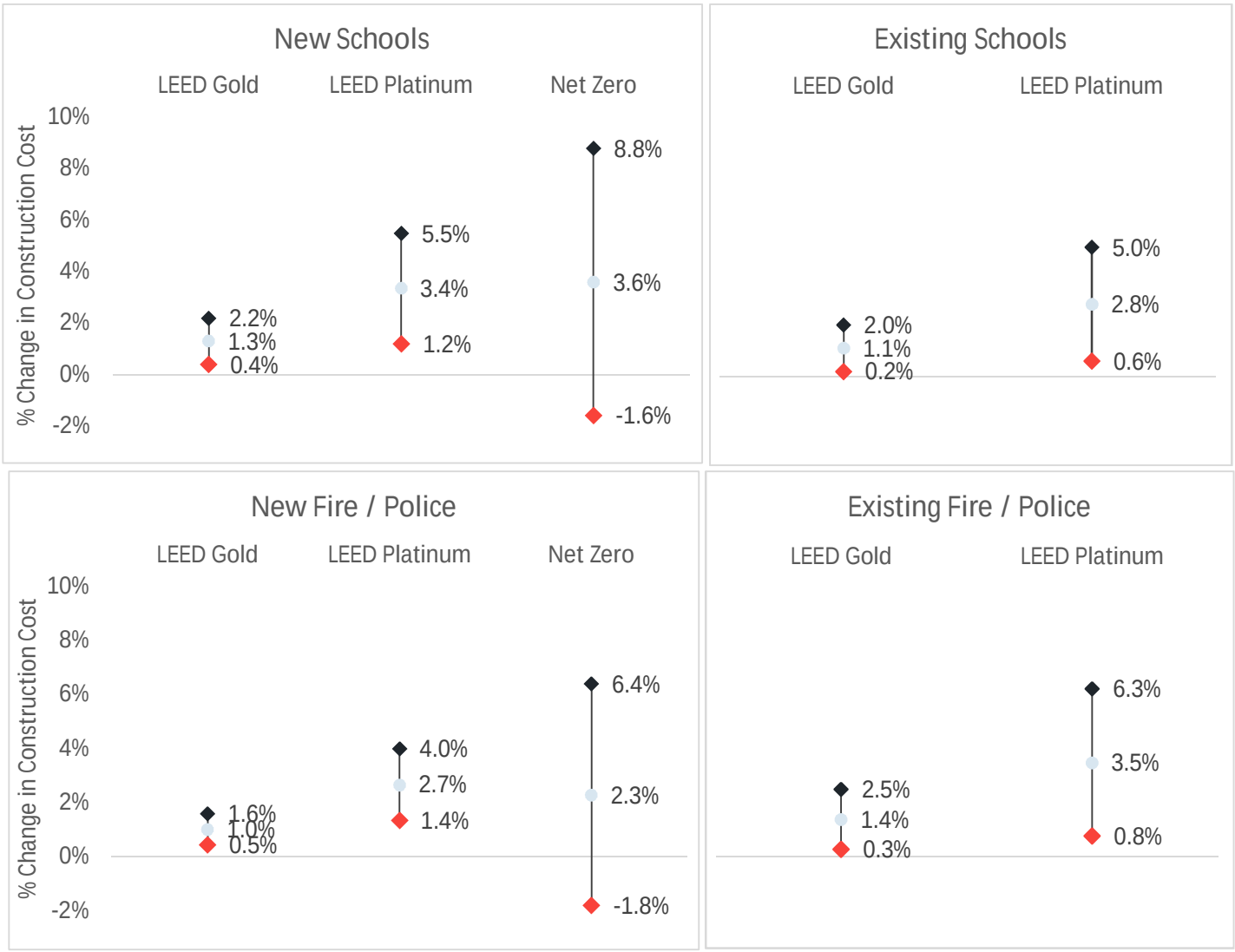
Operating Costs – An increase in the level of LEED certification should not substantially increase the amount of staffing and/or resources the City already uses to monitor and ensure compliance with its existing Green Building Policy. Some upfront changes and updates to documentation used to track the various green building mechanisms used in new developments will be necessary, but no large-scale additional efforts are anticipated from this type of policy change.

If the City's preference is to implement ongoing performance monitoring, such as the energy usage program in place in Arlington County (see section 4.5.2), this type of new policy would require oversight on an ongoing basis as opposed to the current policy which requires documentation at various stages of the development process and proof of certification within two years of the project's completion. Activities such as performance monitoring will require additional staff time and resources to gather and analyze this type of data. However, such activity would result in an increasingly robust dataset of private building energy performance. Coupling this new information with the existing data on City-owned buildings would shed a more expansive light on energy usage throughout Alexandria. Given that LEED requires new construction projects to submit energy and water usage for five years, structuring a data collection process in a similar fashion would minimize additional effort required by property owners. The City staff resources needed to collect and analyze data would hinge on the extent of participation in the project and resulting amount of data. A limited amount would not likely require a time-intensive data management process from the City's perspective, although there would be some upfront initial effort to set up a reliable and efficient/automated process and system (likely by a third-party contract) unless the City has experience with an analogous data collection process in another area or department. If participation is limited to new, larger-scale construction projects, the initial resource requirements to manage data collection and reporting along with building site visits / inspections and related activities would likely be 1 Full Time Employee (FTE).

Costs for Public Buildings – Increasing the green building threshold for City-owned buildings from LEED silver to a more stringent level of certification will have long-term capital cost implications that the City will need to take into consideration. The Green Building Cost Strategies Matrix includes the following estimates of incremental costs for new and existing public buildings, including schools and public safety (fire and police) facilities.

The charts in Figure 3 show the range and midpoint of potential construction cost percentage change by public building use, including new schools (top left chart), existing schools (top right chart), new fire / police buildings (bottom left chart), and existing fire / police buildings (bottom right chart).

Figure 3: Range of Green Building Incremental Percentage Costs for Public Buildings[9]



To further inform the selection and adoption of any of these public green building strategies, the incremental costs will need to be further evaluated and refined by City staff involved with facilities capital improvements. They will also need to be further reviewed through the lens of Alexandria's 10-year Capital Improvement Program (CIP) to gauge the impacts on the City's ability to deliver upon its planned capital investments, including bonding capacity, debt ratio, and credit ratings. For example, the most recent CIP includes $475 million in public school capital improvements over the 10-year period through FY2028, of which, $290 million is allocated towards hard costs of additional building capacity. Although green building practices may not apply to all activities comprising this amount, the high end of the incremental cost range for achieving net-zero energy for new schools and LEED v4 Platinum could range from 6 to 9%, increasing the school capital budget by $20 to $25 million over the period. However, the lifecycle costs would need to be estimated to incorporate ongoing savings from reduced energy and water usage. The overall increased construction costs and ongoing operating cost savings will depend on the specific strategies and technologies implemented. Payback periods for increased first costs can have a broad range depending on these factors, ranging from 6 to 8 years in best case scenarios to as high as 25 to 30 years in some cases. Although reduced energy and water usage can result in significant ongoing cost savings, new-technology systems also require building engineers / facilities managers with the knowledge,

[9] See appendices 5.1-5.3 for more detail

skills, and abilities to operate and maintain these more advanced systems. This need will increase labor costs to some degree, which can offset a small amount of the ongoing savings resulting from reduced utility costs.

Potential Incentive Costs - There is a wide range of options for consideration, including some that do not require the City to incur any cost, and others that may require significant costs depending on how they are structured. Structural incentives such as density bonuses and expedited permitting are the most cost efficient from the City's perspective, although each has constraints specific to Alexandria that limit their feasibility. Other incentives, such as tax credits, may have significant costs and negative fiscal impacts if structured in a way that significantly reduces major revenue sources like real property tax.

4.4 PRIVATE GREEN BUILDING CASE STUDIES

The green building strategies analyzed were applied to the financial feasibility of three new local developments selected by City staff. The City previously engaged WSP to conduct a development pro forma analysis of new construction projects, and the resulting research, analysis, and financial model was leveraged to further test financial sensitivity to the prioritized green building strategies.

The three selected projects include an office building with ground-floor retail, a multifamily apartment development with ground-floor retail, and an attached, for-sale residential project. The following table summarizes the profiles of each development.

CAPITAL COSTS

The previous pro forma was designed to test development financial feasibility in light of all of the City's quantifiable requirements, including its current Green Building Policy mandating LEED Silver / equivalent for non-residential developments and LEED Certified / equivalent for residential projects. As such, previous research on the likely additional costs of green building was cursory and the analysis included assumptions of increased costs ranging from approximately 1% to 2% of hard costs to achieve the City's current mandatory levels.

To estimate the likely capital cost impacts, the midpoint for the silver, gold, and platinum certification cost increases from the matrix were applied as a percentage of hard costs. Given the wide range for net-zero energy, the full range was applied for each case study.

Table 3: Incremental Changes in Green Building Costs

Project	*Square Feet*	*Silver*	*Gold*	*Platinum*	*Net Zero*
Type 1: Office w/GF retail	100,000	$301K $2.95/SF	$661K $6.48/SF	$1.2M $11.49/SF	-$450K - $2.3M -$4.42/SF - $22/SF
Type 2: Multifamily w/GF retail	250,000 Residential 50,000 Retail	$1.1K $3.68/SF	$2.1M $6.78/SF	$3.5M $11.62/SF	-$1.0M – $7.7M -$3.35/SF - $25/SF
Type 3: For-Sale Attached Residential	120,000	$289K $2.45/SF	$566K $4.80/SF	$964M $8.18/SF	-$168K – $2.5M -$1.42/SF - $21/SF

Although the Type 1 project was already subject to LEED Silver, LEED v4 Silver is slightly more stringent than LEED NC 2009 Silver. The Type 2 project includes a mix of residential (subject to LEED Certified) and retail (subject to LEED Silver) use. Based on this mix of uses and differing certification requirements, the incremental cost increase was applied by individual land use.

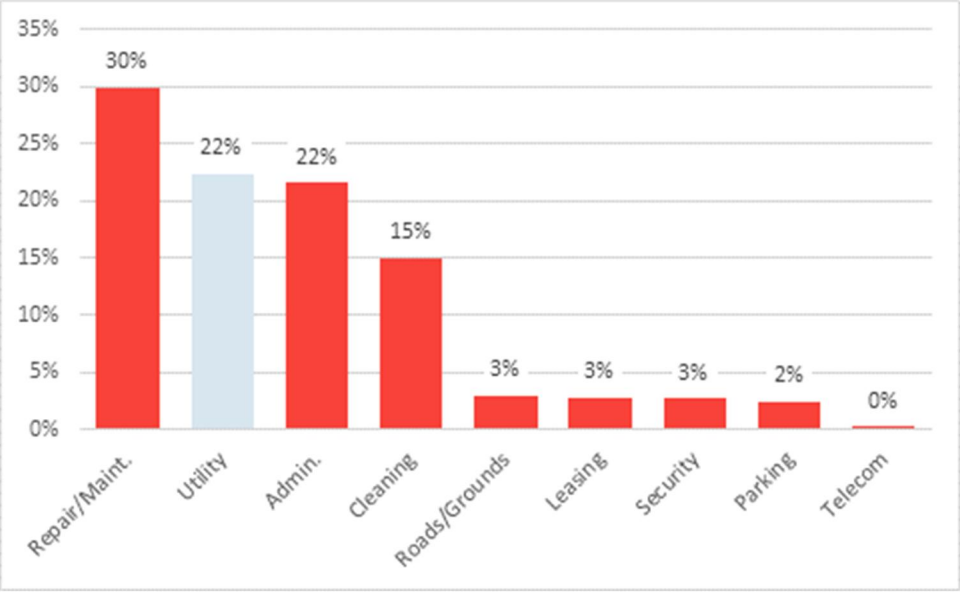
Across all projects, the change to LEED v4 Silver resulted in an increase in hard costs ranging from $2.45 to $3.68 per square foot, LEED v4 gold resulted in increased hard costs ranging from $4.80 to $6.78 per square foot, while the increase to LEED v4 platinum ranged from $8.18 to $11.62 per square foot.

OPERATING COSTS

While much of the focus of green building requirements on new development is centered on potential impacts on upfront capital costs, certain strategies will also impact ongoing operational costs. The most common financial impacts to consider result from reduced energy and water usage. From the perspective of development financial analysis, reduced utility costs will lower overall operating costs and increase net operating income. However, the relative financial impact of these savings depends on the type of development. Owners of leasable office and retail space will seek to reduce operating costs such as utilities. While the lease structure may pass certain costs such as utilities on to the tenant, this will still be reflected in achievable rents. Therefore, an owner of an inefficient office or retail building will be impacted financially in both cases, either from reduced net operating income if the owner bears these costs, or through less competitive achievable rents if high utility costs are passed on to the lessee.

In the previous analysis, operating costs for commercial developments were estimated based on data from the Building Owners and Managers Association (BOMA), International Experience Exchange Report (EER) for Northern Virginia. This data is based on surveys of property managers and owners in the region and was used to generate operating costs as a percentage of gross lease revenue for modelling purposes.

Figure 4: Share of Commercial Operating Costs by Category, Northern Virginia, 2017



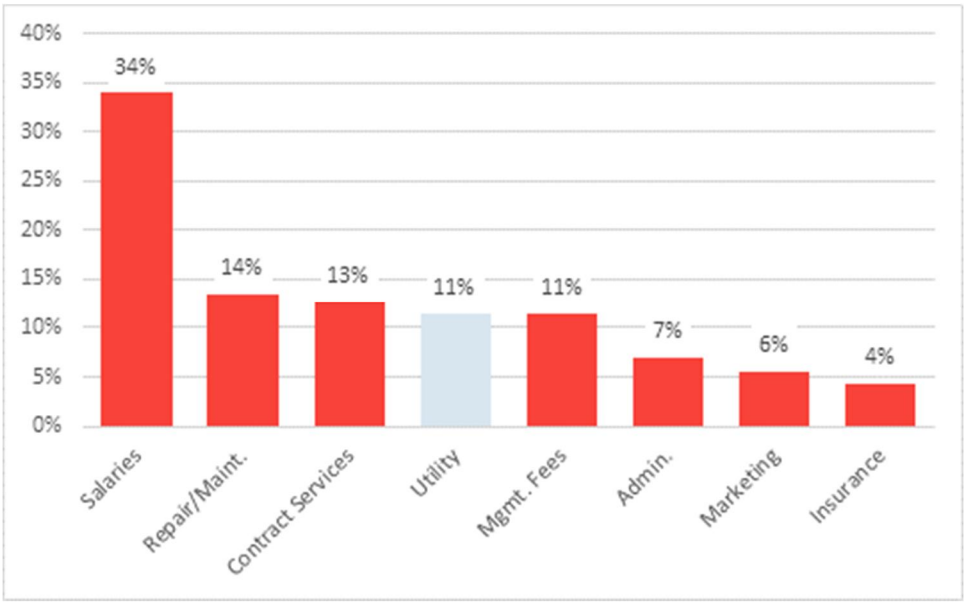
Source: BOMA, WSP Analysis

As shown in Figure 4, utilities represent the second largest operating expense for commercial property owners. As such, any significant reductions resulting from certain green building strategies has the potential to impact overall financial return.

These costs are smaller for new apartment projects where units are typically individually metered and tenants pay for their usage. As such, the owner only pays for energy and water used in common areas. For for-sale residential projects, the developer does not incur ongoing operational costs such as utilities. The extent to which such savings appeal to potential buyers can, however, result in a potential sale price premium if it is a differentiating factor relative to competitors.

To estimate operating costs for apartment projects, data from the National Apartment Association (NAA) Survey of Operating Income and Expenses for the Washington, DC region was used. Like the BOMA EER report, survey data based on actual apartment projects in the region were used to estimate an operating cost assumption calculated as a percentage of gross apartment lease revenue.

Figure 5: Share of Apartment Operating Costs by Category, Washington, DC Region, 2017



Source: NAA, WSP Analysis

As shown in Figure 5, utilities represent a lower share of apartment operating costs relative to commercial buildings. For office buildings ranging from 100,000 to 300,000 square feet, utility costs averaged $1.76 per square foot versus $0.66 per square foot for mid- and high-rise apartments surveyed in the region. As a result, the green building strategies proposed that serve to reduce utility costs have the greatest impact on the life-cycle cost of the office case study relative to the multifamily case study project and have no positive or negative effect on the developer's financial return of the for-sale residential case study.

This difference in utility costs highlights the split-incentive problem that can reduce adoption of green building investment in residential developments. In these scenarios, the entity making the green building investment does not reap the direct benefits of the resulting lifecycle cost savings and therefore may be less likely to adopt such practices. Without offsetting operating cost reductions, landlords will charge higher rents to achieve the required return. However, for those tenants whose key consideration is total rent (i.e. those less focused on selecting a green apartment), effective marketing can convey the extent to which their reduced water and energy bills will offset the rent premium and result in net savings over time.

FINANCIAL FEASIBILITY IMPACTS

Detailed estimates of project costs and revenues were generated in the previous pro forma and combined to develop project net cash flows. These pro formas were used as a baseline to further analyze the recommended green building strategies proposed in this analysis. The financial feasibility of the three selected projects were evaluated using multiple profitability metrics depending on the revenue profile of the project (lease revenue versus revenue from sales).

> **Yield on Cost[10] (YOC):** YOC is a commonly used metric to evaluate projects that generate lease revenue. To Calculate YOC, stabilized net operating income (NOI) is divided by total project costs. NOI represents gross lease revenue net of operating costs. Green building strategies that increase development costs will increase the denominator, thereby reducing the project's YOC. However, strategies that reduce operating costs will increase the numerator (NOI) in the YOC calculation. Change in YOC was used to evaluate impacts to project Type 1 and Type 2, but is not applicable for projects with one-time sales revenue like project Type 3.

[10] Yield on cost is also sometimes referred to as return on cost (ROC) or rate of return (ROR) on total capital; The YOC is a metric that can be easily compared to current capitalization rates for existing properties, as an indicator of whether a development project might be feasible. The capitalization rate (cap rate) is the ratio of the net operating income (NOI) to property asset value (based on recent property transactions), and provides an idea of the percentage return a real estate investor would receive on an all cash purchase. Developers interviewed in the region for the previous development pro forma analysis were seeking development opportunities with a YOC around 6% for the strongest locations, based in prevailing cap rates at the time.

Return on Investment (ROI): ROI is a simple metric used to evaluate developments that generate sales revenues. It is calculated by dividing cumulative net profit by total development cost and represents a simple calculation to estimate the return of for-sale projects that do not have long-term operating revenue and costs. ROI will highlight the extent to which total sales revenue is higher than the various development costs (land acquisition and construction costs). If the City's green building mandates increase these costs, ROI will decline accordingly. Change in ROI was used to evaluate impacts to project Type 3.

Internal Rate of Return (IRR):[11] IRR factors in project cash flows over time and accounts for the timing of project costs and revenue as a measure of return. To facilitate comparison, IRR was calculated for all projects. A developer, lender, or investor's target IRR, YOC, and ROI can vary depending on several factors including perceived project risk, land use, debt structure (unleveraged vs. leveraged IRR), and other factors. Anecdotally, it is not uncommon for for-sale residential projects to have a range of target unleveraged IRRs from 8% to 20%, apartments ranging from 7%-12%, and office ranging from 8-12%.

Results reflected in the table below show the estimated change in each project's unleveraged IRR, change in YOC for project Type 1 and project Type 2, and change in ROI for project Type 3.

Table 4: Green Building IRR and YOC Impacts[12]

	Internal Rate of Return (IRR)					Yield on Cost (YOC)					Return on Investment (ROI)				
Project	Base Case	Silver	Gold	Plat.	NZE	Base Case	Silver	Gold	Plat.	NZE	Base Case	Silver	Gold	Plat.	NZE
Type 1	10.7%	10.5%	10.4%	10.1%	9.7-10.9%	7.9%	7.8%	7.7%	7.7%	7.5-8.0%	-	-	-	-	-
Type 2	8.2%	8.2%	8.1%	7.9%	7.4-8.5%	5.9%	5.9%	5.9%	5.8%	5.6-6.0%	-	-	-	-	-
Type 3	5.0%	4.9%	4.3%	3.6%	0.9-5.8%	-	-	-	-	-	8.2%	8.0%	7.1%	5.9%	1.5-9.4%

The results of the analysis show that an increase to both gold and platinum certification standards did not have a dramatically negative impact on financial return for both the Type 1 and Type 2 projects. For the Type 3 project, an increase to gold reduced project financial return slightly, but the increase to platinum had a more significant negative impact. The low end of the relatively wide range for net-zero energy showed diminished returns for Type 1 and 2, and made Type 3 financially infeasible.

AFFORDABLE HOUSING GREEN BUILDING COST CONSIDERATIONS

The modeling approach to estimate financial feasibility described above was designed to test the sensitivity of three new construction development case studies selected by City staff to show impacts on a small cross section of representative commercial and market-rate residential projects. It does not, however, shed light on the potential impacts that more stringent green building thresholds might have on proposed affordable housing developments or renovations, which tend to have very different financing structures relative to private developments. Participation in the Low-Income Housing Tax Credit (LIHTC) program is typically a vital element of financial feasibility, but these developments must compete for LIHTC credits from a limited pool administered by the Virginia Housing Development Authority (VHDA). Project development costs factor heavily into VHDA's system of scoring LIHTC applications. Therefore, a new green building policy that results in increased affordable housing development costs may cause Alexandria applicants to be less competitive in the state-level LIHTC application process.

[11] To simplify the results of the analysis and facilitate comparison, unleveraged IRR was calculated for all projects. Unleveraged IRR was chosen over leveraged to eliminate the need for debt structure assumptions, which could vary significantly by project and require somewhat speculative assumptions as a result.

[12] Market-driven assumptions for gross revenue were estimated based on previous pro forma analysis, which included likely achievable rents/SF and stabilized occupancy for new construction office (Type 1) and apartment product (Type 2), and achievable for-sale pricing and absorption (Type 3) in the Alexandria submarket.

In addition to scoring competing applicants based on development costs, VHDA also awards points for achieving certain green building thresholds. However, overall project costs far outweigh green building achievement in VHDA's evaluation process. Applicants can receive up to 300 points in the "Efficient Use of Resources" category, which is based on total development costs and low-income housing credit/cost.[13] However, they receive just 10 points for achieving any of the following green building certifications – Earthcraft Gold, LEED Certified, Enterprise Green Communities, or National Green Building Standard Silver. Given the sensitivity that these projects have to construction costs in the LIHTC application process, we recommend that any updated policy implemented by the City allow for flexibility to review affordable housing new construction and renovation projects on a case-by-case basis to ensure that the policy does not result in a less competitive LIHTC application.

4.5 POTENTIAL INCENTIVE PROGRAMS

4.5.1 INCENTIVE PROGRAM OVERVIEW

Municipalities both regionally and nationally have increasingly implemented various programs to incentivize targeted green building practices. The most common incentives associated with green building policies typically fall into two general categories: 1) financially driven incentives such as tax credits, grants, or fee reductions, and 2) structural programs that allow a jurisdiction to offer benefits via the approvals process, such as expedited permitting or bonus densities.

Initial research suggests that there is no single specific incentive category that has proven more successful or effective than others, and that programs should be scenario specific and customized to local development dynamics. While not an exhaustive list, the USGBC is currently tracking over 700 federal, state, and local-level green building policies, of which 175 are incentive-based programs enacted by local governments. These policies are further classified into four broad categories: density bonus, tax credits, expedited permitting, and "other."

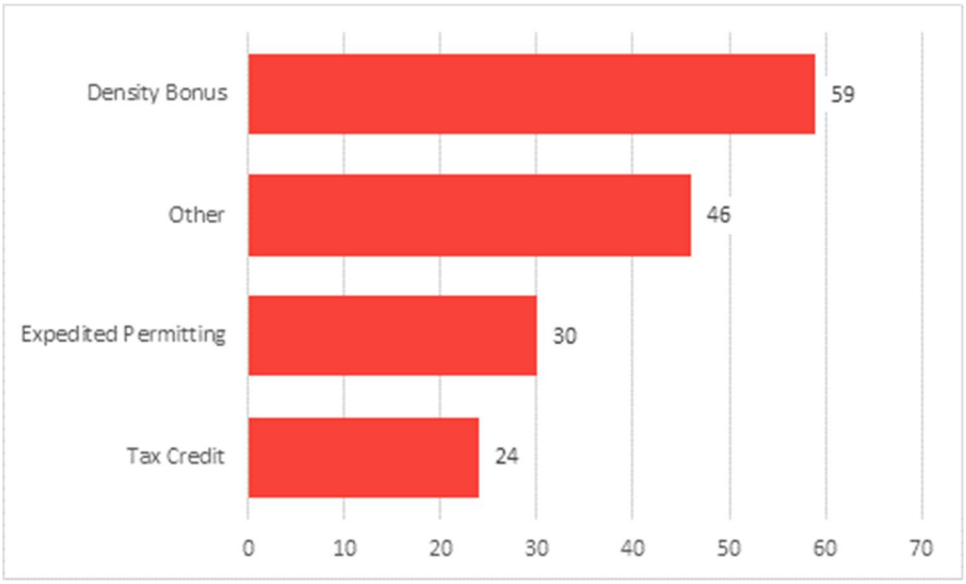
- Density/Height Bonus – in exchange for meeting certain defined levels of green building, a jurisdiction may offer an increase in density (floor-area ratio (FAR)) and/or height of the proposed new development. Additional density/height allows for the developer to generate increased revenue in the form of rent or sales on the same parcel of land. In addition to the incremental revenue-generating potential of the bonus, the value of this incentive to a developer also depends on the incremental costs of the increased green building implementation. It is important for a jurisdiction to have a good understanding of the current state of the development industry's standard green building practices, so as not to incentivize green building thresholds that may already be planned / generally accepted in the local market.
- Tax Incentives – Local jurisdictions may offer various forms of tax incentives to spur investment in green building practices. Tax-based incentives can take on many forms, including tax credits, abatements, or rebates, and can be tailored to incentivize specific activities based on the locality's goals, policies, or identified gaps in sustainable practices. As such, the magnitude of fiscal investment can vary significantly depending on the defined policy. For example, on the lower end of the financial scale, rebates for upgrading residential units with Energy Star products can be offered to local residents. These incentives can amount to as little as $500 to $1,000 per applicant per year, and can help reduce the footprint of a city's existing residential inventory. However, the relative city-wide benefits of a smaller-scale program such as this may not substantially outweigh the administrative costs, depending on the process, ease of implementation, and level of adoption. On the other end of the spectrum, jurisdictions can offer property tax abatements to incentivize various levels of green building certification for new, large-scale developments as well. These programs can effectively motivate developers to achieve high levels of green building certification, although the program's specific tax reductions should be studied carefully to determine the overall fiscal impacts due to reduced real property tax revenue.
- Expedited Permitting – Many jurisdictions offer expedited permitting in exchange for green building commitments. This type of structural incentive does not require a monetary cost on the part of the municipality, and can result in cost savings to the developer. A shorter review period reduces the developer's carrying costs, such as interest on the land acquisition, property taxes, and other ongoing expenses prior to developing and generating revenue.

[13] https://www.vhda.com/BusinessPartners/MFDevelopers/LIHTCProgram/LowIncome%20Housing%20Tax%20Credit%20Program/2019%20Manual-%20FINAL%202.0.pdf

- Other Incentives – aside from density bonus, tax credits, and expedited permitting, the USGBC classifies all other local incentives into an "other" category. This category represents a variety of mechanisms, but a review of those tracked by the USGBC suggest that the majority of these revolve around the permitting process, and primarily include permitting fee reductions and waivers.

The amount of these incentive categories adopted nationwide by local jurisdictions is shown in Figure 6.

Figure 6: Incentive-Based, Local Government Green Building Policies Tracked by USGBC, United States, 2018



Source: USGBC, WSP Analysis

Based on this policy inventory, density bonus programs are the most widely adopted form of incentives at the local level. After the broadly defined *Other* category, expedited permitting and tax credits comprise lower levels of local implementation.

These results are logical for several reasons. While each mechanism provides a benefit in exchange for the cost of increased green building, the potential for higher density tends to be the most appealing to developers, and does not require the municipality to forego any potential revenue from tax credits or reduced/waived fees. While expedited permitting offers the potential for near-term developer cost reductions, these represent a relatively small share of overall development costs, and are also temporary. On the other hand, the increased revenue potential from a density bonus will exist for the life of the project and can have a far greater impact on long-term project value. Conceptually, a real property tax credit could be structured in a way to provide similar incremental value from the developer's perspective, but a credit of such scale is not likely to be in the local jurisdiction's best fiscal interest, given that real property tax revenue is often the largest source of local general fund revenue. It is to be noted that performance based programs generally require more oversight from the city in terms of staffing, data collection, and other administrative tasks.

4.5.2 PROGRAM AVAILABILITY AND APPLICABILITY

Although there is a wide variety of green building mechanisms that have proven effective nationally and internationally, the Commonwealth of Virginia's status as a Dillon Rule state limits the City's available options to those that have been expressly addressed in state-level statutory language. Various elements of the Virginia State Code generally address the categories of green building incentives described above, and includes language regarding incentive zoning (bonus density, expedited permit/fee

reductions, waivers, etc.), tax treatment of green buildings (tax incentives), establishment of green building zones, and other programs encouraging sustainable building practices.[14]

DENSITY BONUS

As noted above, use of the density bonus mechanism is a common practice at the local level due to its high level of appeal to developers and low level of required public investment. Density bonus programs are most suitable in established, urban areas with strong real estate market conditions and limited supply of developable land, such as the Northern Virginia region. Unlike financial incentives, the bonus density mechanism requires minimal cost incurred by the City other than administration to ensure compliance with the program.

Virginia Examples - In the region, Arlington County pioneered a green building density bonus program in 1999, and has refined the incentive periodically (in 2003, 2009, 2012, and 2015) to reflect the latest trends in green building development and ensure that the County is not incentivizing an industry standard practice. The County's most recent program iteration includes the following incentives for commercial office and multifamily developments:

- LEED v4 Silver – 0.25 FAR
- LEED v4 Gold – 0.35 FAR
- LEED v4 Platinum – 0.50 FAR
- Additional 0.05 FAR for "priority credits" identified by the County[15]
- Additional requirements include:
    - Energy Star certification for commercial office uses
    - Energy Star lighting and appliances for multifamily uses
    - 10 years of energy reporting through Energy Star Portfolio Manager submission

The County has updated its program over the years based on market dynamics, evolving certifications/classifications, and other observed factors. For example, in its most recent update, the program shifted its focus to performance-based metrics including the Energy Star requirements and annual energy usage reporting to better align with the County's energy performance goals. While the previous version of the program was effective in achieving certain levels of LEED certification on new construction projects, it did not ensure or provide evidence of ongoing benefits. The implementation of the Energy Star elements and ongoing data reporting provide the County with the necessary assurance that buildings are meeting performance standards long after completion and initial certification. Additionally, this data is now a very useful tool for County staff to track progress towards its stated energy performance goals; it provides a valuable and increasingly robust dataset that allows for the identification of results and trends, and can inform future policy decisions related to energy use.

In recent years, the vast majority of Arlington developments subject to plan review have participated in the program, indicating that the value of the bonus FAR thresholds are worth more than the costs associated with the requirements of each level of certification. Ensuring compliance with the program requires a somewhat complicated oversight process, due in part to the impossibility of removing density once construction is complete. Developers are required to issue an assurance bond in an amount calculated based on the scale of the project, which they will receive back after a specified time period. If the development ultimately does not comply with the program requirements, the bond defaults to the County. To date, the County has not had to resort to this measure on any participating developments.

Applicability in Alexandria – The bonus density concept has proven to be an effective mechanism to incentivize green building throughout the country, including in neighboring Arlington County. Alexandria could consider increasing its base green building requirements (such as, to LEED Gold) and consider offering a density bonus or other incentive for meeting more stringent standards. The critical remaining question is to what extent adoption of a green building bonus density might adversely impact the efficacy of Alexandria's existing affordable housing bonus density program (Section 7-700).

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[14] § 58.1-3221.2. "Classification of certain energy-efficient buildings for tax purposes"
§ 58.1-3854. "Creation of local green development zones"
§ 15.2-958.3. "Financing clean energy programs"

[15] https://environment.arlingtonva.us/wp-content/uploads/sites/13/2016/11/Arlington-Priority-Credits.pdf

Potential Impact on Affordable Housing: While the effectiveness of Arlington's green building density bonus is well documented, the County also uses a bonus density mechanism to encourage delivery of affordable housing units. A discussion with a member of the Arlington Economic Development office indicated that the success of the green building bonus has not had a negative impact on the County's affordable housing bonus, nor does the presence of both programs force an "either/or" decision between participation in one bonus program over the other. The two programs coexist without conflict due to how the existing base densities and bonus densities are structured in the zoning code. Zoning for a given parcel includes a base FAR, while the affordable housing bonus and green building bonus combine to reach the maximum FAR allowed based on the parcel's zoning. In almost every case, the developer has sought to maximize FAR and taken advantage of both bonus density programs.

The lesson learned is that if applicable zoning for a parcel in Alexandria is structured in a way that allows for a similar base FAR to be increased to a maximum FAR by combining the affordable housing bonus with a green building bonus, then the new policy is unlikely to hinder participation in the existing affordable housing program. If, however, the 30% density bonus currently provided through the existing program brings a project to its maximum FAR already, then adding a new green building bonus option has the potential to force a decision between one program or the other, and is therefore likely to erode participation in the affordable housing program to some extent. In this case, for both programs to coexist without negatively impacting the current affordable housing program, the maximum allowable density would need to be increased. The program could also be structured so that the green building density bonus is available only to developers who have first maximized the affordable housing density bonus. This type of prioritized structure is recommended because it would ensure that any new green building density bonus would not impact the existing affordable housing density bonus program.

TAX INCENTIVES

Tax incentives have been used by jurisdictions in Virginia and elsewhere in the region to foster various levels of green building implementation. Unlike structural incentives such as the density bonus, tax-based incentives provide a financial incentive to the applicant in the form of reduced taxes, which does come at a cost to the municipality in the form of reduced tax revenue. As noted above, these mechanisms can be structured in a variety of ways depending on the desired scale of financial incentive, target audience, and other applicable factors.

Examples in Virginia and Washington, DC Region – Virginia code expressly allows for the "classification of certain energy-efficient buildings for tax purposes," which allows local jurisdictions to offer a reduced real property tax rate to incentivize green building development. Only a few Virginia municipalities have taken advantage of this statute, the details of which are shown in Table 5.

Table 5: Summary of Virginia Municipalities Offering Real Property Tax Incentives for Green Building[16]

Locality	Incentive
City of Roanoke	10% reduction in real property tax rate for five years
City of Charlottesville	50% reduction in real property tax rate for one year
Spotsylvania County	40% reduction in real property tax (in place from 2013 to 2014)
City of Virginia Beach	15% reduction in real property tax

The above real property tax reductions apply to any building that exceeds Virginia building code energy efficiency requirements by 30% or more. In the DC region, Montgomery County in Maryland provides a far more detailed incentive program offering 10 different incentives, customized by level and type of certification, scale of development, and new construction versus existing buildings:

Table 6: Montgomery County, MD, Real Property Tax Credits for Green Building[17]

Certification	Incentive
Commercial or multifamily new construction or major renovation over 10,000 GSF	
gold rating for LEED- New Construction (NC) or LEED-Core and Shell (CS)	25% of the property tax owed on the building for 5 years

[16] § 58.1-3221.2. "Classification of certain energy-efficient buildings for tax purposes"
[17] https://www.montgomerycountymd.gov/finance/taxes/tax_credit_exempt.html#p19

platinum rating for LEED-NC or LEED-CS	75% of the property tax owed on the building for 5 years
gold rating for LEED-Existing Building (EB)	10% of the property tax owed on the building for 3 years,
platinum rating for LEED-EB	50% of the property tax owed on the building for 3 years
Any other building	
silver rating for LEED-NC or LEED-CS	25% of the property tax owed on the building for 5 years
gold rating for LEED-NC or LEED-CS	50% of the property tax owed on the building for 5 years
platinum rating for LEED-NC or LEED-CS	75% of the property tax owed on the building for 5 years
silver rating for LEED-EB	10% of the property tax owed on the building for 3 years
gold rating for LEED-EB	25% of the property tax owed on the building for 3 years
platinum rating for LEED-EB	50% of the property tax owed on the building for 3 years

Montgomery County's program provides 10 different detailed levels of tax credits, each with varying levels of tax reductions and durations. This level of detail serves several important purposes:

1) It results in an incentive program that is comprehensive with respect to land uses, including both new construction and renovation scenarios, for both large-scale and small-scale building types;
2) The variation in tax reductions and length of credit help lessen the overall negative fiscal impact to the County from reduced property tax revenue. Existing buildings that are already contributing to annual real property tax collections have lower overall reductions (10%-50% vs. 25%-75% for new construction) and shorter time frames (3 vs. 5 years);
3) It further incentivizes green building on smaller-scale projects, which are eligible for a lower threshold of LEED silver, compared to larger projects that must achieve LEED gold to be eligible.

This type of structure is a good local example of a green building policy with the necessary level of detail and customization required to be both comprehensive in property eligibility and limited in net negative fiscal impact.

Applicability in Alexandria - While the City is currently able to influence desired green building policies for larger-scale projects through the site plan review process, it has less leverage with smaller developments not subject to site plan review and projects involving existing buildings. In these scenarios, where structural incentives are less applicable, adoption of a financial incentive such as a tax credit is worth considering to achieve the City's desired green building outcomes. The fiscal impacts of any type of tax credit mechanism need to be carefully considered, especially if it is a comprehensive policy such as the program in Montgomery County. A more limited-scale tax credit program could also be customized to help fill specific gaps remaining after other mechanisms and incentives have been deployed. In this manner, a tax credit mechanism could play a more complementary role as part of a broader set of mechanisms with reduced fiscal impacts to the City. A tax credit program targeting both new buildings not subject to plan review and renovation of existing buildings (such as those previously referenced in Footnote 14) would help make the City's Green Building Policy more comprehensive when combined with other mechanisms geared towards new buildings subject to site plan review. Exclusion of larger-scale new developments would lessen the negative fiscal impacts of such a tax credit as well.

OTHER MECHANISMS

Commercial Property Assessed Clean Energy (C-PACE) –Virginia has provided localities to adopt an ordinance to create a local C-PACE program, which provides commercial property owners with a unique financing mechanism to pay for green building investments for both renovations and new construction. To date, Arlington County is the first local government to implement the program, although other localities are considering the option, including the City of Alexandria. The City should continue to explore the feasibility of this option given its potential to encourage green building practices at relatively low costs to the City to administer. While it is a voluntary program that applies to both new construction and renovations, it could be a complement to other mechanisms that do not apply to existing building renovations (such as the density bonus) to further encourage green building practices in this land use category.

Table 7: Summary of Incentives and Recommendations

Mechanism	Eligible Projects	Strengths	Weaknesses	Local Considerations	Recommendation
Bonus Density	New construction subject to site plan review	Broad appeal from developers; successful track record in region	Potential for controversy if resulting density exceeds what is allowed through existing zoning	Likely to negatively impact City's affordable housing bonus density if maximum FAR achievable with 1 of 2 competing bonus programs	Consider only if zoning scenarios do not force a choice between bonus density of green building and affordable housing;
Tax Incentives	New and existing buildings	Can tailor extent of incentive to control magnitude of fiscal impacts	Reduced fiscal revenue depending on the incentive structure	Likely best option for smaller projects where City does not have leverage of plan review process	Recommended if it is legal to tailor to certain targeted building types / categories
Expedited Permitting	New construction	Structural incentive requiring no cost borne by City	Difficult to apply uniform green building requirement since monetary benefit / savings to developer can vary depending on financing structure, land costs, etc.	City's building permitting timeline is already quite short	Not recommended / applicable – short existing permitting timeline limits potential benefit
Other: Permitting fee reduction / waiver	New construction and renovations	Attractive to developers seeking to reduce upfront soft costs	Represents small share of total development costs	City's higher-cost fees and contributions are dedicated to fund specific uses (e.g. sewer tap fees)	Not recommended for larger projects – majority of fees and contributions fund specific needs, and magnitude of developer benefit not likely sufficient to incentivize significant green building upgrades
Other: C-PACE	New and existing buildings	Clear benefit to property owner bottom line (cash flow) from low cost financing; Good fit for major rehab / renovation projects	City level of effort to implement – contracting w/third-party administrator, public outreach / education	City is exploring potential of C-PACE program	Continue learning process; consider implementation given potential with larger renovation projects

5 APPENDICES

5.1 GREEN BUILDING COST MATRIX STRATEGIES BY PERCENT

FIRST COST RANGES BY PROJECT TYPE (% OF FIRST COSTS)

		SUMMARY			NEW PRIVATE DEVELOPMENT						EXISTING PRIVATE DEVELOPMENT *						NEW PUBLIC DEV.				EXISTING PUBLIC DEV.			
		0	0	0	OFF		MF		SML		COM		MF		SF		SCHOOL		FIRE / POLICE		SCHOOL		FIRE / POLICE	
	STRATEGY	Δ	$	!	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
		0	0	0																				
CERTIFICATIONS	LEED v4 Certified				-0.3%	0.5%	-0.2%	0.6%	-0.2%	0.8%	-0.1%	0.8%	-0.2%	0.7%	0.0%	0.8%	-0.2%	0.6%	-0.3%	0.4%	-0.1%	0.5%	-0.2%	0.6%
	LEED v4 Silver				0.0%	2.0%	0.0%	2.4%	0.0%	3.2%	0.0%	3.0%	0.0%	2.8%	0.0%	3.0%	0.0%	2.2%	0.0%	1.6%	0.0%	2.0%	0.0%	2.5%
	LEED v4 Gold				1.4%	2.9%	1.1%	3.5%	0.7%	4.6%	0.4%	4.4%	0.8%	4.1%	0.1%	4.4%	1.1%	3.2%	1.3%	2.3%	0.6%	2.9%	0.7%	3.6%
	LEED v4 Platinum				2.9%	4.8%	2.3%	5.8%	1.5%	7.7%	0.7%	7.2%	1.7%	6.7%	0.3%	7.2%	2.3%	5.3%	2.6%	3.8%	1.2%	4.8%	1.5%	6.0%
	Net-Zero Energy				-1.5%	7.5%	-1.2%	9.0%	-0.8%	12.0%	N/A	N/A	N/A	N/A	N/A	N/A	-1.2%	8.3%	-1.4%	6.0%	N/A	N/A	N/A	N/A
ENERGY / GSG	TOTAL				3.4%	14.7%	2.7%	17.7%	1.7%	23.6%	0.8%	21.6%	2.0%	20.2%	0.3%	21.6%	2.7%	16.2%	3.0%	11.8%	1.3%	14.4%	1.6%	18.0%
	Improved Building Envelope				0.0%	1.2%	0.0%	1.4%	0.0%	1.9%	0.0%	1.8%	0.0%	1.7%	0.0%	1.8%	0.0%	1.3%	0.0%	1.0%	0.0%	1.2%	0.0%	1.5%
	Efficient Building Systems				0.5%	2.9%	0.4%	3.4%	0.3%	4.6%	0.1%	4.3%	0.3%	4.0%	0.1%	4.3%	0.4%	3.2%	0.5%	2.3%	0.2%	2.9%	0.3%	3.6%
	Integrated Building Controls				0.3%	0.8%	0.2%	1.0%	0.1%	1.3%	0.1%	1.2%	0.2%	1.1%	0.0%	1.2%	0.2%	0.9%	0.2%	0.6%	0.1%	0.8%	0.1%	1.0%
	Commissioning (Fund. + Enhanced)				0.1%	0.3%	0.1%	0.4%	0.1%	0.5%	N/A	N/A	N/A	N/A	N/A	N/A	0.1%	0.3%	0.1%	0.2%	N/A	N/A	N/A	N/A
	Ongoing Performance / M&V				0.2%	0.4%	0.1%	0.5%	0.1%	0.6%	0.0%	0.6%	0.1%	0.5%	0.0%	0.6%	0.1%	0.4%	0.2%	0.3%	0.1%	0.4%	0.1%	0.5%
	Energy Intensity Targets (EUI) -30%				0.9%	5.2%	0.7%	6.2%	0.4%	8.3%	0.2%	7.8%	0.5%	7.2%	0.1%	7.8%	0.7%	5.7%	0.8%	4.1%	0.3%	5.2%	0.4%	6.5%
	Energy Intensity Targets (EUI) 38				1.5%	4.0%	1.2%	4.8%	0.8%	6.4%	0.4%	6.0%	0.9%	5.6%	0.2%	6.0%	1.2%	4.4%	1.4%	3.2%	0.6%	4.0%	0.8%	5.0%
WATER	TOTAL				0.1%	0.6%	0.1%	0.7%	0.1%	1.0%	0.0%	0.7%	0.0%	0.7%	0.0%	0.7%	0.1%	0.7%	0.1%	0.5%	0.0%	0.5%	0.0%	0.6%
	Outdoor Water Savings				0.0%	0.2%	0.0%	0.3%	0.0%	0.3%	0.0%	0.3%	0.0%	0.3%	0.0%	0.3%	0.0%	0.2%	0.0%	0.2%	0.0%	0.2%	0.0%	0.3%
	Indoor Water Savings				0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Process Water Savings				0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%
	Commissioning				0.1%	0.1%	0.0%	0.1%	0.0%	0.2%	N/A	N/A	N/A	N/A	N/A	N/A	0.0%	0.1%	0.1%	0.1%	N/A	N/A	N/A	N/A
	Ongoing Performance / M&V				0.1%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%	0.1%
	Water Metering & Performance				0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%
STORMWATER	TOTAL				0.4%	1.4%	0.3%	1.7%	0.2%	2.2%	0.1%	2.1%	0.3%	1.9%	0.0%	2.1%	0.3%	1.5%	0.4%	1.1%	0.2%	1.4%	0.2%	1.7%
	Green Infrastructure (ground)				0.1%	0.7%	0.1%	0.8%	0.1%	1.1%	0.0%	1.0%	0.1%	0.9%	0.0%	1.0%	0.1%	0.7%	0.1%	0.5%	0.0%	0.7%	0.1%	0.8%
	Green Infrastructure (roof)				0.1%	0.3%	0.1%	0.3%	0.1%	0.5%	0.0%	0.4%	0.1%	0.4%	0.0%	0.4%	0.1%	0.3%	0.1%	0.2%	0.1%	0.3%	0.1%	0.4%
	Rainwater Collection				0.2%	0.4%	0.1%	0.5%	0.1%	0.7%	0.0%	0.6%	0.1%	0.6%	0.0%	0.6%	0.1%	0.5%	0.2%	0.3%	0.1%	0.4%	0.1%	0.5%

LEGEND

N/A - Strategy impractical for most projects

NOTES

Cost estimates are based on published financial studies, reports, and our experience

Cost estimates for each strategy are based on a variety of assumptions that need to be vetted with the City

A summary of the building types has been included in the assumptions table in the report

5.2 GREEN BUILDING COST MATRIX STRATEGIES BY COST

FIRST COST RANGES BY PROJECT TYPE ($)

		SUMMARY			NEW PRIVATE DEVELOPMENT						EXISTING PRIVATE DEVELOPMENT						NEW PUBLIC DEV.				EXISTING PUBLIC DEV.			
		0	0	0	OFF		MF		SML		COM		MF		SF		SCHOOL		FIRE / POLICE		SCHOOL		FIRE / POLICE	
	STRATEGY	Δ	$	!	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
		0	0	0																				
CERTIFICATIONS	LEED v4 Certified				-$62,700	$104,500	-$115,920	$289,800	-$30,600	$163,200	-$15,675	$156,750	-$86,940	$338,100	-$6,120	$153,000	-$50,160	$114,950	-$56,430	$83,600	-$25,080	$104,500	-$31,350	$130,625
	LEED v4 Silver				$0	$418,000	$0	$1,159,200	$0	$652,800	$0	$627,000	$0	$1,352,400	$0	$612,000	$0	$459,800	$0	$334,400	$0	$418,000	$0	$522,500
	LEED v4 Gold				$292,600	$606,100	$540,960	$1,680,840	$142,800	$946,560	$73,150	$909,150	$405,720	$1,960,980	$28,560	$887,400	$234,080	$666,710	$263,340	$484,880	$117,040	$606,100	$146,300	$757,625
	LEED v4 Platinum				$606,100	$1,003,200	$1,120,560	$2,782,080	$295,800	$1,566,720	$151,525	$1,504,800	$840,420	$3,245,760	$59,160	$1,468,800	$484,880	$1,103,520	$545,490	$802,560	$242,440	$1,003,200	$303,050	$1,254,000
	Net-Zero Energy				-$313,500	$1,567,500	-$579,600	$4,347,000	-$153,000	$2,448,000	N/A	N/A	N/A	N/A	N/A	N/A	-$250,800	$1,724,250	-$282,150	$1,254,000	N/A	N/A	N/A	N/A
ENERGY / GSG	TOTAL				$703,800	$3,077,400	$1,301,188	$8,534,263	$343,481	$4,806,045	$170,725	$4,522,050	$533,040	$6,089,024	$67,915	$4,485,519	$563,040	$3,385,140	$633,420	$2,461,920	$273,160	$3,014,700	$341,450	$3,768,375
	Improved Building Envelope				$0	$250,800	$0	$695,520	$0	$391,680	$0	$376,200	$0	$811,440	$0	$367,200	$0	$275,880	$0	$200,640	$0	$250,800	$0	$313,500
	Efficient Building Systems				$104,500	$600,000	$193,200	$1,663,923	$51,000	$937,033	$26,125	$900,000	$144,900	$1,941,244	$10,200	$878,469	$83,600	$660,000	$94,050	$480,000	$41,800	$600,000	$52,250	$750,000
	Integrated Building Controls				$52,250	$167,200	$96,600	$463,680	$25,500	$261,120	$13,063	$250,800	$72,450	$540,960	$5,100	$244,800	$41,800	$183,920	$47,025	$133,760	$20,900	$167,200	$26,125	$209,000
	Commissioning (Fund. + Enhanced)				$20,900	$62,700	$38,640	$173,880	$10,200	$97,920	N/A	N/A	N/A	N/A	N/A	N/A	$16,720	$68,970	$18,810	$50,160	N/A	N/A	N/A	N/A
	Ongoing Performance / M&V				$35,000	$80,000	$64,708	$221,856	$17,081	$124,938	$8,750	$120,000	$21,000	$112,000	$3,500	$120,000	$28,000	$88,000	$31,500	$64,000	$14,000	$80,000	$17,500	$100,000
	Energy Intensity Targets (EUI) -30%				$177,650	$1,080,700	$328,440	$2,997,003	$86,700	$1,687,753	$44,413	$1,621,050	$106,590	$1,512,980	$17,765	$1,621,050	$142,120	$1,188,770	$159,885	$864,560	$71,060	$1,080,700	$88,825	$1,350,875
	Energy Intensity Targets (EUI) 38				$313,500	$836,000	$579,600	$2,318,400	$153,000	$1,305,600	$78,375	$1,254,000	$188,100	$1,170,400	$31,350	$1,254,000	$250,800	$919,600	$282,150	$668,800	$125,400	$836,000	$156,750	$1,045,000
WATER	TOTAL				$26,220	$129,340	$48,476	$358,686	$12,796	$201,993	$3,430	$156,510	$4,079	$269,672	$1,385	$154,093	$20,976	$142,274	$23,598	$103,472	$5,488	$104,340	$6,860	$130,425
	Outdoor Water Savings				-$6,500	$44,000	-$12,017	$122,021	-$3,172	$68,716	-$1,625	$66,000	-$9,013	$142,358	-$634	$64,421	-$5,200	$48,400	-$5,850	$35,200	-$2,600	$44,000	-$3,250	$55,000
	Indoor Water Savings				$960	$6,840	$1,775	$18,969	$469	$10,682	$240	$10,260	$1,331	$22,130	$94	$10,015	$768	$7,524	$864	$5,472	$384	$6,840	$480	$8,550
	Process Water Savings				$260	$16,500	$481	$45,758	$127	$25,768	$65	$24,750	$361	$53,384	$25	$24,158	$208	$18,150	$234	$13,200	$104	$16,500	$130	$20,625
	Commissioning				$12,500	$25,000	$23,110	$69,330	$6,100	$39,043	N/A	N/A	N/A	N/A	N/A	N/A	$10,000	$27,500	$11,250	$20,000	N/A	N/A	N/A	N/A
	Ongoing Performance / M&V				$12,500	$17,500	$23,110	$48,531	$6,100	$27,330	$3,125	$26,250	$7,500	$24,500	$1,250	$26,250	$10,000	$19,250	$11,250	$14,000	$5,000	$17,500	$6,250	$21,875
	Water Metering & Performance				$6,500	$19,500	$12,017	$54,078	$3,172	$30,454	$1,625	$29,250	$3,900	$27,300	$650	$29,250	$5,200	$21,450	$5,850	$15,600	$2,600	$19,500	$3,250	$24,375
STORMWATER	TOTAL				$90,000	$290,000	$166,392	$804,230	$43,923	$452,900	$22,500	$435,000	$124,794	$938,268	$8,785	$424,593	$72,000	$319,000	$81,000	$232,000	$36,000	$290,000	$45,000	$362,500
	Green Infrastructure (ground)				$25,000	$140,000	$46,220	$388,249	$12,201	$218,641	$6,250	$210,000	$34,665	$452,957	$2,440	$204,976	$20,000	$154,000	$22,500	$112,000	$10,000	$140,000	$12,500	$175,000
	Green Infrastructure (roof)				$30,000	$60,000	$55,464	$166,392	$14,641	$93,703	$7,500	$90,000	$41,598	$194,124	$2,928	$87,847	$24,000	$66,000	$27,000	$48,000	$12,000	$60,000	$15,000	$75,000
	Rainwater Collection				$35,000	$90,000	$64,708	$249,589	$17,081	$140,555	$8,750	$135,000	$48,531	$291,187	$3,416	$131,770	$28,000	$99,000	$31,500	$72,000	$14,000	$90,000	$17,500	$112,500

LEGEND

N/A - Strategy impractical for most projects

NOTES

Cost estimates are based on published financial studies, reports, and our experience

Cost estimates for each strategy are based on a variety of assumptions that need to be vetted with the City

A summary of the building types has been included in the assumptions table in the report

5.3 GREEN BUILDING COST MATRIX ASSUMPTIONS

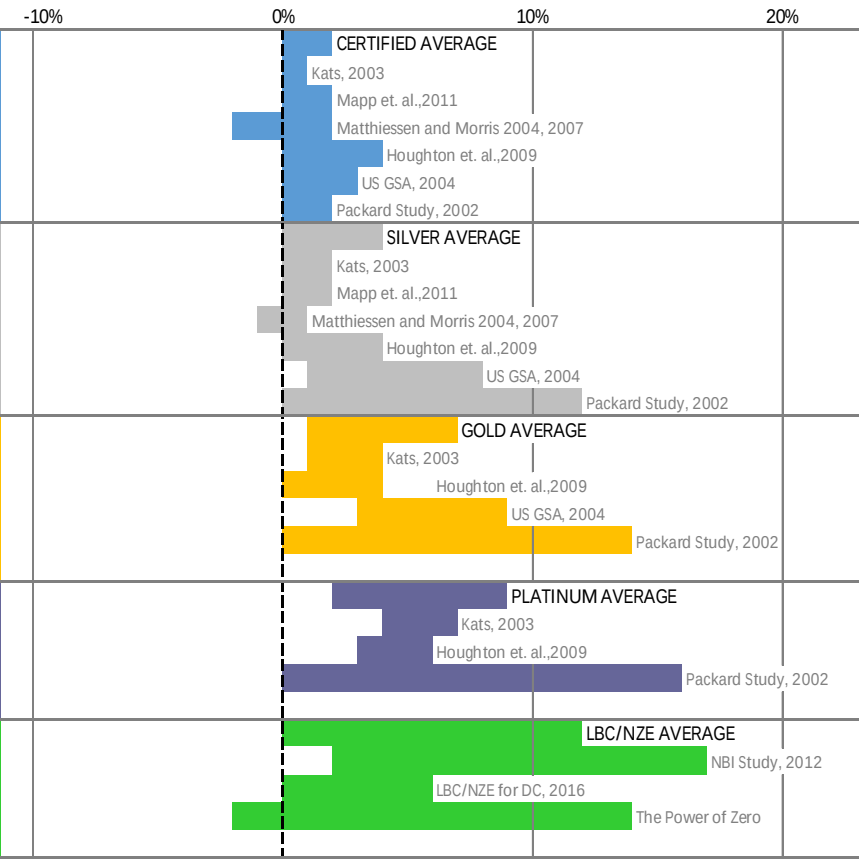
	STRATEGY	BASELINE	LOW COSTS ASSUMPTIONS	LOW COSTS $	HIGH COSTS ASSUMPTIONS	HIGH COSTS $
CERTIFICATIONS	**LEED v4 Certified**	LEED 2009 NC SILVER	LEED V4 NC Certified is roughly equivalent to LEED 2009 NC Silver but well coordinated project teams can achieve cost savings.	($62,700)	LEED V4 NC Certified is roughly equivalent to LEED 2009 NC Silver but some changes may be more challenging for some project teams.	$104,500
	LEED v4 Silver		LEED V4 NC Silver is slightly more stringent than 2009. Some teams will achieve this with no additional cost.	$0	LEED V4 NC Silver is slightly more stringent than 2009. Some teams will achieve this with some additional cost.	$418,000
	LEED v4 Gold		LEED V4 NC Gold will require project teams to achieve some of the new and updated requirements in LEED v4.	$292,600	LEED V4 NC Gold will require project teams to achieve some of the new and updated requirements in LEED v4.	$606,100
	LEED v4 Platinum		LEED V4 NC Platinum is a significant stretch for most projects. Strong teams will make smart trade-offs to manage cost.	$606,100	LEED V4 NC Platinum is a significant stretch for most projects. Some projects will need to make significant investments to achieve this.	$1,003,200
	Net-Zero Energy		Net-Zero Energy projects can be designed and optimized for energy AND cost savings. When proper cost management is used, these projects can cost less than typical. This is party due to the power of establishing a single, measurable goal that allows the D&C team to weigh cost tradeoffs.	($313,500)	Some projects and design teams will not be able to achieve on-site Net-Zero Energy but may be able to buy into community solar projects to achieve this outcome.	$1,567,500
ENERGY / GSG	Improved Building Envelope	ASHRAE 90.1 2010 energy code baseline w/ 60% WTW ratio	50% improvement in window, wall, and roof R-values. Light to Solar Gain ratio for glazing above 2.1. WTW ratio reduced to 40%. 35% reduction in heating and cooling load associated with building envelope.	$0	50% improvement in window, wall, and roof R-values. Light to Solar Gain ratio for glazing above 2.1. WTW ratio remains the same,. 35% reduction in heating and cooling load associated with building envelope.	$250,800
	Efficient Building Systems	ASHRAE 90.1 20X10 energy code baseline for Water-cooled DX w/ VAV's	Improved MEP systems achieve 30% improvement in annual energy cost (for energy associated with HVAC systems) and are "right-sized" to meet reduced building loads.	$104,500	Improved MEP systems achieve 30% improvement in annual energy cost (for energy associated with HVAC systems) and are not "right-sized" to meet reduced building loads.	$600,000
	Integrated Building Controls	Standard BMS and controls. Very limited submetering for lighting and HVAC.	Smart BMS and energy management system provides real-time energy monitoring, alerts, and insights. System is operated to manage and reduce annual energy use.	$52,250	Smart BMS and energy management system provides real-time energy monitoring, alerts, and insights. System is not operated effectively to manage and reduce annual energy use.	$167,200
	Commissioning	LEED 2009 Fundamental Commissioning	LEED v4 Fundamental + Enhanced Cx. w/ strong Cx team providing insights that reduce annual energy use.	$20,900	LEED v4 Fundamental + Enhanced Cx. w/ typical Cx team focused on LEED cert.	$62,700
	Ongoing Performance / M&V	LEED 2009 Measurement & Verification Plan developed but not implemented.	LEED v4 Monitoring-Based Cx + Advanced Metering + 2-year M&V / performance contract	$35,000	LEED v4 Monitoring-Based Cx + Advanced Metering + 2-year M&V contract	$80,000
	EUI Target - 30% reduction	See baseline assumptions above. *	30% reduction in EUI beyond LEED 2009 baselines. *	$177,650	30% reduction in EUI beyond typical code compliant building.	$1,080,700
	EUI Target - 38 kBtu / SF / Yr.	See baseline assumptions above. *	Highly integrated D&C team with low-energy building experience.. Very good building envelope, efficient "right-sized" systems, 45%-50% reduction in annual energy use.	$313,500	Typical D&C team, limited low-energy building experience. Very good building envelope, efficient, systems not "right-sized", 45%-50% reduction in annual energy use.	$836,000
WATER	Outdoor Water Savings	LEED 2009 NC baseline	100% water use reduction. Now permanent irrigation, low-water plantings.	($6,500)	Greywater collection and reuse + efficient irrigation to achieve 50% water use reduction.	$44,000
	Indoor Water Savings	LEED 2009 NC prerequisite (20%)	40% indoor water savings with typical low-flow fixtures.	$960	40% indoor water savings with typical low-flow fixtures.	$6,840
	Process Water Savings	No process water savings	Efficient cooling tower management.	$260	Greywater collection and reuse for irrigation	$16,500
	Commissioning	LEED 2009 Fundamental Commissioning	LEED v4 Fundamental + Enhanced Cx. w/ strong Cx team providing insights that reduce annual water use.	$12,500	LEED v4 Fundamental + Enhanced Cx. w/ strong Cx team providing insights that reduce annual water use.	$25,000
	Ongoing Performance / M&V	No M&V	Water management monitoring and plan	$12,500	Water management monitoring and plan	$17,500
	Water Metering & Performance	No water sub-metering	Water sub-meters for indoor, outdoor, and process water uses.	$6,500	Water sub-meters for indoor, outdoor, and process water uses.	$19,500
STORMWATER	Green Infrastructure (ground)	Design meets city stormwater requirements.	Low-impact design strategy to retain 75th percentile storm event. Rain garden or equivalent.	$25,000	Extensive low-impact design strategies (or underground vault) to manage 95th percentile storm event.	$140,000
	Green Infrastructure (roof)	Design meets city stormwater requirements.	Extensive green roof on 25% or roof area + blue roof design.	$30,000	Intensive greenroof on 75% of roof area.	$60,000
	Rainwater Collection	No rainwater collection	Rainwater collection to manage 75th percentile storm event.	$35,000	Rainwater collection to manage 95th percentile storm event.	$90,000

	TYPE	NOTES	FIRST COSTS
BUILDING TYPES	(OFF) OFFICE w/ GF Retail	Project size, type, and cost is based on proforma provided to City	$20,900,000
	(MF) Multifamily w/ GF Retail	Project size, type, and cost is based on proforma provided to City	$48,300,000
	(SML) For Sale Attached Res.	Project size, type, and cost is based on proforma provided to City	$20,400,000
	(COM,MF,SF) Existing Private Development	The existing private developments are assumed to be major renovations, the same size as the new developments. The costs associated with major renovations can vary significantly depending on the building type, changes, and existing conditions.	
	(SCHOOL, FIRE/POLICE) New Public Development	New public developments are assumed to be 100,000 SF of development. This may include two 50,000 SF schools or four 25,000 fire stations.	
	(SCHOOL, FIRE/POLICE) Existing Public Development	The existing public developments are assumed to be major renovations, the same size as the new developments. The certifications costs do not apply to minor renovations and improvements.The costs of individual strategies may apply to some minor improvements. The costs associated with major renovations can vary significantly depending on the building type, changes, and existing conditions.	

* See Integral report for baseline EUI targets
** Blue cells indicate costs that will not be incurred if the baseline building is assumed to meet the current City codes and mandates
*** Yellow cells indicate options that correspond with recommendations in the Integral Group report, Tables 8 and 9

5.4 SUMMARY OF GREEN BUILDING COST STUDIES*

#	STUDY	LOW	HIGH	
	CERTIFIED AVERAGE	-0.3%	2.3%	CERTIFIED
1	Kats, 2003	0.0%	1.0%	
2	Mapp et. al.,2011	0.0%	2.0%	
3	Matthiessen and Morris 2004, 2007	-2.0%	2.0%	
4	Houghton et. al.,2009	0.0%	4.0%	
5	US GSA, 2004	0.0%	3.0%	
6	Packard Study, 2002	0.0%	2.0%	
	SILVER AVERAGE	0.1%	4.8%	SILVER
7	Kats, 2003	0.0%	2.0%	
8	Mapp et. al.,2011	0.0%	2.0%	
9	Matthiessen and Morris 2004, 2007	-1.0%	1.0%	
10	Houghton et. al.,2009	0.0%	4.0%	
11	US GSA, 2004	1.5%	8.0%	
12	Packard Study, 2002	0.0%	12.0%	
	GOLD AVERAGE	1.5%	7.8%	GOLD
13	Kats, 2003	2.0%	4.0%	
14	Houghton et. al.,2009	0.0%	4.0%	
15	US GSA, 2004	4.0%	9.0%	
16	Packard Study, 2002	0.0%	14.0%	
18				
	PLATINUM AVERAGE	3.0%	9.7%	PLATINUM
19	Kats, 2003	5.0%	7.0%	
20	Houghton et. al.,2009	4.0%	6.0%	
21	Packard Study, 2002	0.0%	16.0%	
23				
	LBC/NZE AVERAGE	0.7%	12.3%	LBC/NZE
25	NBI Study, 2012	3.0%	17.0%	
26	LBC/NZE for DC, 2016	1.0%	6.0%	
27	The Power of Zero	-2.0%	14.0%	
28				



* These cost studies used cost information for a variety of building types in different regions around the US.