City of Alexandria Green Building Policy:
Final Technical Report

Prepared for:

City of Alexandria, Virginia

Developed by:

Integral Group

2021 L Street NW, 2nd Floor, Washington, DC 20036

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www.integralgroup.com

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1. Executive Summary

Below is a summary of recommendations for effective approaches to updating the City of Alexandria's Green Building Policy, with the goal of providing the greatest impact toward achieving the City's environmental goals. Strategies are recommended based on relative impact as well as the City's ability to implement effectively.

Strategy A: New Construction Standards and Directed Use

EAP Actions 3.1.a and 3.1.d: "Increase LEED or equivalent third-party green building certification standards for private development" and "prioritize specific green building elements" in private development projects.[1]

Recommendation: All private projects, both commercial and residential, that require a Development Site Plan (DSP) or Development Special Use Permit (DSUP), should achieve green building performance at or above the LEED Silver standard, or an equivalent standard as determined by the City. In addition, projects should be designed to meet performance levels for energy and water as listed in Table 1. For ease of implementation, Alexandria may check whether a building has received credits equivalent to this performance threshold in LEED or an equivalent standard; these references to the relative number of points per standard are in the full report.

Table 1: Summary of Strategy A Performance Targets

Energy	
Energy Performance - EUI targets:	• < 35 kBTU/ft^2 for multifamily residential buildings • < 45 kBTU/ft^2 for commercial (with exceptions for hospitals, food service, and schools) • < 30 kBTU/ft^2 for schools • Note: Buildings with energy intensive uses such as hospitals, laboratories and food service are exempt from EUI targets, however should target at 30%+ improvement over a 90.1-2010 baseline, and a 15%+ improvement over code.
Renewable Energy:	Buildings subject to DSUP should be designed to have 5% of their total site energy supplied by onsite renewable energy
Commissioning:	Achieve a minimum 3 points in "Enhanced Commissioning" under LEED V4/V4.1.
Measurement and Verification:	Implement energy metering for the whole building and any end uses making up over 10% of the building load.
Water	
Indoor Water Use	Reduction of 40% or greater than baseline water use (per LEED V4 baseline values).
Outdoor Water Use Reduction	Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period, OR Achieve 50% reduction in water use for landscape irrigation, compared to the baseline for the site's peak watering month.

[1] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25.

Stormwater	
Stormwater Management	No requirement over and above City's standard stormwater requirement, established April 2018.
Performance Monitoring	
Performance Monitoring	Track data on environmental performance outcomes using free software tools and share with City on an ongoing basis.

Strategy B: New and Existing Public Buildings

EAP Action 3.1.b: Establish a separate green building standard for new public development, at a level more ambitious than required for private development and evaluate the feasibility of a net zero standard for new public development, including schools.[2]

To lead by example, all new public development projects, including schools, should be certified at the LEED Gold level or higher and be designed to achieve the performance requirements outlined in Table 2. The City should consider the use of performance-based procurement to incentivize higher levels of environmental performance while neutralizing cost impacts.

Table 2: Summary of Strategy B Performance Targets

Energy	
Energy Performance	Be designed to achieve net zero energy (NZE) through a combination of energy efficiency and renewable energy systems, either on-site or using off-site renewables as needed.
Water	
Indoor Water Use	Reduction of 40% or greater than baseline water use (per LEED V4 baseline values).
Outdoor Water Use Reduction	Reduce irrigation water use by at least 50% relative to the calculated baseline for peak watering month, and where possible, use plants that require no irrigation with potable water after a maximum two-year establishment period.
Stormwater	
Stormwater Management	Meet 100% of the stormwater treatment requirements for sites with green infrastructure and evaluate options for over-treating and/or detaining additional rainwater on site.
Human Health	
IAQ	Require baseline for no/low VOC materials to improve Indoor Environmental Quality.
Health and Wellness	Incorporate human health into building design process from beginning of projects.

In addition, the report lays out a series of recommendations for improving the energy performance of existing public buildings through Strategic Energy Management and targeted capital investments.

[2] Ibid.

Strategy C: New Private Development not subject to site plan review

EAP Action 3.1.e: "Introduce voluntary green building practices…for small buildings not subject to site plan review."[3]

The City should consider the below mechanisms for encouraging improved environmental performance for small buildings not subject to site plan review.

Home Rating and Labeling Programs

A home rating is made up of a series of measures that can be achieved to attain points for a higher rating: Education, Site, Energy, Water, Indoor Environmental Quality, Materials and Resources, and Innovations.

Education and Capacity Building

Education programs for industry, including developers, architects and engineers as well as internally for City staff can improve the baseline knowledge and local industry capacity to deliver high performance buildings.

Strategy D: Existing Private Buildings

EAP Action 3.1.e: "Introduce mandatory and/or voluntary green building practices for existing buildings (including historic)."[4]

The City should consider the below mechanisms for encouraging improved environmental performance for existing buildings.

Challenge Programs and Benchmarking

Promoting benchmarking to track and improve energy use is a mechanism for raising awareness of relative energy use of buildings, and opportunities for improvements and increased efficiency. Many jurisdictions have had success in promoting energy efficiency through voluntary challenge programs, either between buildings in the jurisdiction or between jurisdictions.

Educational Programs

Many building owners and managers don't know how to make their property greener. Educational resources from the local government can be very helpful.

Green Leases and Tenant Build-Out

Green leasing realigns the financial incentives of the landlord and tenant to support energy or sustainability goals in the lease documents. These leases overcome the split incentive problem, whereby landlords and tenants are dis-incentivized to undertake energy efficiency upgrades in a building, as neither realizes the full benefit of the upgrades.

[3] Ibid.
[4] Ibid.

Coordination with Utility Efficiency Programs

Dominion Energy is developing substantial new energy efficiency programs, which will be operating in the next 10 years. Dominion has begun development of these programs and identified the City of Alexandria as a named stakeholder.

Property-Assessed Clean Energy

Commercial Property-Assessed Clean Energy (C-PACE) is an innovative way to finance clean energy projects on commercial, multifamily, and non-profit buildings (excluding condos and properties with less than five dwellings).

Strategy E: Incentives for All New and Existing Privately-Owned Buildings

EAP Action 3.1.c: "Establish incentives for private development participation in green building certifications."[5]

The City should consider introduction of the below structural and financial incentives. These incentives are further discussed in another report commissioned by the City from WSP.

Floor Area Exclusions to Accommodate Passive Design Elements

This is a mechanism that allows passive design elements (such as exterior insulation) to be excluded from the permitted floor area ratio or extend into designated set back distance, thus encouraging improving energy efficiency without negatively impacting developable space or building value.

Density (FAR) and/or Height Bonus

While density bonuses are widely used in other jurisdictions, this is not a priority recommendation for all of the City of Alexandria, because of historic density restrictions and the importance of existing affordable housing bonuses. However, there are select areas of the city, such as Potomac Yards or Eisenhower East, where there is great potential for additional density, and a density and/or height bonus could be beneficial. We recommend Alexandria investigate establishing Green Zones in such areas and allowing additional density in return for higher levels of green building and energy performance.

Tax Incentives

Tax-based incentives provide a financial incentive to the applicant by way of a reduction in taxes—financial incentives are largely outside the scope of this report, but would be beneficial especially for encouraging Net Zero Energy or Living Building Challenge projects, or for reaching smaller projects not subject to site plan review.

[5] Ibid.

2. Project Objectives

This report provides recommendations for effective approaches to updating the City of Alexandria's Green Building Policy, with the intent of providing the greatest impact toward achieving the City's environmental goals. Strategies are recommended based on relative impact as well as the City's ability to implement effectively. This final report presents our findings and incorporates input and direction from the City of Alexandria and the City's Green Building Policy Update Task Force.

3. Background

The City of Alexandria's Green Building Policy, introduced in 2009, applies to new public and private development subject to Development Site Plan (DSP) or Development Special Use Permit (DSUP) review. The current policy requires non-residential buildings to achieve LEED Silver (or equivalent standard, such as Green Globes), and residential buildings to achieve LEED Certified (or equivalent standard such as Earthcraft and ICC-700 National Green Building Standard).

Alexandria has already made great progress as a result of its existing Green Building Policy. According to data provided to Integral Group by City staff, under the current policy, 14 projects have achieved LEED certification, including five at the Gold level. Additionally, several projects have been certified using Green Globes, Earthcraft, or the ICC-700 Green Building Standard. In addition, 18 projects are currently under construction, and another eight projects are completed and pending certification.[6] Another 38 projects have been approved but have not begun construction.[7] Overall, according to USGBC, 12.86 million square feet have received LEED certification in Alexandria (though this statistic may double-count properties that achieved multiple LEED certifications, such as a property built to LEED for New Construction and re-certified for Existing Building Operations and Maintenance, or for tenant spaces that were certified with LEED for Interior Design inside of a LEED Core and Shell building).[8] As part of this project, a review was done of the particular LEED credit achievements under LEED v2009 for the purpose of establishing a baseline against which to evaluate performance; the results of this analysis can be found in Appendix B.

The City is electing to revise the Green Building Policy to ensure new and existing building projects contribute to achievement of the goals and targets in the Environmental Action Plan (EAP) Phase 1, adopted by City Council in October 2018. Further, the City is considering setting more stringent environmental performance targets for public projects (City-owned buildings) to lead by example.

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[6] City of Alexandria. 2017. "Table #1: Green Building Policy Compliant Development Projects Under Construction or Completed from 2010 to Present" https://www.alexandriava.gov/uploadedFiles/planning/info/GreenBldgProjectsUnderConstructionorComplete2010thru2016.pdf Accessed February 25, 2019

[7] City of Alexandria. 2017. "Table #2: Active Development Projects Subject to Green Building Policy (adopted April 2009)" https://www.alexandriava.gov/uploadedFiles/planning/info/GreenBldgTable2ActiveDevelopmentGBProjectsJune2017.pdf Accessed February 25, 2019

[8] "Alexandria, Virginia, Green Building Information Gateway" (2019). U.S. Green Building Council. Retrieved from http://www.gbig.org/places/6413 on February 14, 2018.

The City hired Integral Group to recommend potential strategies to improve energy, greenhouse gas, water and stormwater management performance in new and existing public and private buildings ranging from single family homes to multifamily and large commercial and institutional development.

In this report, we are proposing a pathway for each building type, along with estimated impacts of each proposed strategy. To measure impacts, we compared projected performance under an updated policy against both demonstrated performance of buildings constructed under the existing policy, and improvement over code or conventional design.

4. Examined Green Building Strategies

The scope of this project is to review, make recommendations, and measure potential impacts for five green building strategies. The five strategies were selected by the Green Building Policy Update Task Force established by the Alexandria City Council. The strategies vary by building type, whether the building is subject to development site plan review, whether the building is private or City-owned, and for new construction or existing buildings. Specific recommended strategies discussed in section 6 were selected based on potential environmental impact, and feasibility of implementation by the City. The selection and prioritization of the strategies as well as the approach to impact analysis are discussed in section 5.

Below is the list of the five green building strategies that originated in the City's Environmental Action Plan, and refined by City staff and the Task Force.

1. **New Private Commercial and Multifamily Development (subject to site plan review)** - Increase LEED or equivalent third-party green building certification standards for private development and prioritize specific green building elements in private development projects.

2. **New and Existing Public Buildings** - Establish a separate green building standard for new public development, at a level more ambitious than required for private development and evaluate the feasibility of a net zero standard for new public development, including schools.

3. **New Private Development (not subject to site plan review)** - Introduce voluntary green building practices for small buildings not subject to site plan review.

4. **Existing Private Buildings (Commercial, Multifamily, and Single Family)** - Introduce voluntary green building practices for existing buildings (including historic).

5. **Incentives for All New and Existing Privately-Owned Buildings -** Establish incentives for private development to incorporate green building elements.

5. Approach and Methods

5.1 Current State Review

5.1.1 Current Green Building Policy & Outcomes

To inform our analysis and recommendations, our team began by reviewing Alexandria's current Green Building Policy and the outcomes of the policy to date. The City provided the scorecards and certifications for all buildings that have been subject to the Green Building Policy since its inception in 2009. Our team aggregated the available data on building certification levels and points or credits achieved and generated a summary report of the quantitative results of these building projects. We calculated average performance in energy, water and stormwater management. This average performance comprises the baseline results of Alexandria's current Green Building Policy and informs the recommended performance targets for the revised Green Building Policy. Because LEED standards have changed significantly since its inception, we only examined LEED v2009 and LEED v4 projects for the purpose of establishing a baseline. See Appendix B for further details on this analysis.

5.1.2 Document Review

The City provided a set of plans, policies and administrative procedures for review. This document review allowed us to understand the context under which the Green Building Policy exists, which informs our recommendations for the future policy. Importantly, this review gave our team an understanding of the current administrative procedures in place to track, review and assess compliance for buildings subject to the Green Building Policy, including what is required by the applicant and by City staff. Our recommendations are further informed by the energy, greenhouse gas emissions, water use reduction and stormwater management targets in the City's Environmental Action Plan. We calculated the capacity for buildings to meet the proposed targets to support achievement of the targets established in the EAP Phase 1 document.

5.2 Best Practice Review

While the City of Alexandria has a clear idea of its desired future state in terms of performance per the Environmental Action Plan, we conducted a scan of existing best practices in other jurisdictions to inform the approach to the new Green Building Policy. Our best practice review included cities with a similar size, climate zone, administrative capacity, regulatory jurisdiction, development typology and/or with similarly ambitious long-range environmental targets.

Strategies from other jurisdictions informed our recommendations in two ways: (1) we scanned performance targets from different jurisdictions to understand the range of energy, GHG, water and stormwater conservation and management practices required of building projects in the jurisdictions; and (2) we scanned the approach – the policy, regulatory, incentive or programmatic structure that either requires or encourages higher levels of environmental performance. We also considered the level of effort and administrative burden on behalf of both the applicant and the City.

The best practices review is summarized in Appendix A, along with a comparison of how Alexandria ranks in terms of green building achievements relative to other cities with similar policies and/or of similar size or density to Alexandria. A brief summary of the policy comparisons is found in Table 3.

Table 3: LEED Policy Highlights for Peer Jurisdictions

City	Green Building Policy[9]
Alexandria, VA*	LEED Silver for Commercial / LEED Certified for Multifamily
Seattle, WA	Aggressive EUI targets (<35 kBtu/ft2); LEED Gold required for projects requesting zoning amendments; Living Building Challenge incentives
Santa Monica, CA	NZE for single-family and low-rise multifamily; Density bonus for non-residential projects that meet LEED Platinum along with other local requirements.
Berkeley, CA	LEED Gold for buildings in downtown area (LEED Certified elsewhere)
Washington, DC	International Green Construction Code; LEED Silver for private new construction over 50,000 ft2 and LEED Gold for public new construction; Optional NZE code path with goal of NZE code requirement by 2026; Stormwater retention requirement of 1.2"
St. Paul, MN	LEED Silver or better, along with local priority credits
Cambridge, MA	LEED Silver for buildings over 50,000 ft2; NZE goal by 2040
Boston, MA	LEED Certified plus local priority credits
Arlington, VA*	Density bonus for LEED Silver (0.25 FAR) through LEED Platinum (0.5 FAR), with additional bonus for local priority credits
Burlington, VT*	Height and density bonus may be permitted by City for construction or renovations that achieve LEED Silver certification; additional density bonus available to buildings in the downtown achieving LEED Gold or Platinum.
Newark, DE*	LEED certification required for site plan approval in high density areas
Nashua, NH*	Permit fee discounts of 5%-20% for LEED certification, depending on the level of certification.

** City/County is in a Dillon Rule State*[10]

5.3 Impact Assessment

To measure the impact of key strategies, we reviewed the performance of buildings under the existing policy. This allowed us to establish a business-as-usual (BAU) case that reflected the median impact of the existing policy in order to ensure that the new policy would be more ambitious.

When designing a green building and getting certification points for energy use reductions, project teams measure the modeled performance against what the performance would be if built according to a baseline energy code. While every state adopts its own codes, most base their codes on the national model codes developed by the International Code Council (ICC) and the American Society of Heating,

[9] Policy Information source: U.S. Green Building Council | Public Policy Library. (2019). Retrieved from https://public-policies.usgbc.org/, with supplementary verification on city websites.
[10] National Association of Counties. (2004). Dillon's Rule or Not?. Washington, DC. Retrieved from https://web.archive.org/web/20151010114031/http://celdf.org/downloads/Home%20Rule%20State%20or%20Dillons%20Rule%20State.pdf

Refrigerating and Air-Conditioning Engineers (ASHRAE). Most projects built in Alexandria under the current Green Building Policy used the LEED v2009 rating system, which referenced ASHRAE 90.1-2007 as the baseline code for energy performance. The newer LEED v4 references ASHRAE 90.1-2010 as the baseline for optimizing energy performance, while LEED 4.1 references ASHRAE 90.1-2016. In 2018, Virginia adopted a new energy code based on the International Energy Conservation Code (IECC) 2015 and ASHRAE 90.1-2013.

To inform the analysis of the reference baseline, we reviewed studies by the Pacific Northwest National Laboratory (PNNL) to determine typical energy use intensity (EUI) for the 4A climate zone (which contains Virginia) under ASHRAE 90.1, versions 2007, 2010, 2013, and 2016.[11,12,13] We also reviewed modeled EUIs under stretch codes for other jurisdictions in the 4A climate zone, such asthe New York Stretch Code, for which modeling was done using the same 4A climate reference point of Baltimore.[14,15] Given that the average energy improvement for projects under the existing green building policy was 26% relative to 90.1-2007, we can estimate an average EUI for buildings built in Alexandria. In estimating the BAU energy use with future growth, we assumed that future buildings of would be built at either the average achieved EUI under the current policy, or the projected EUI under the current code, whichever was lower for each building type.

Table 4: Typical Energy Use Intensities by Building Type in Climate Zone 4A, Under Various Baselines

Building Type	90.1-2007 (LEED v2009 baseline) (kBtu/ft^2) [11]	90.1-2010 (LEED v4 baseline) (kBtu/ft^2) [11]	90.1-2013 / IECC 2015 – Current VA Energy Code (kBtu/ft^2) [12]	90.1-2016 (LEED v 4.1 baseline) [13]	New York Stretch Code (kBtu/ft^2) [14]	Estimated average EUI achievement in Alexandria under existing policy (kBtu/ft^2)
Multifamily	62.4	53.0	50.7	45.4*	56.2	46.1
Commercial (all)	71.9	59.2	54.6	54.9	45.7	53.2
Office	84.0	71.4	59.6	67.2*	56.2	62.2
School	52.2	44.4	36.7	36.6*	30.2	38.6
Hotel	67.3	57.2	46.9	41.8*	39.8	49.8
Retail	107.3	91.2	70.3	85.2*	56.5	79.4

** EUIs specific to 4A for 90.1-2016 were not available at the time of this publication for these specific building types*

[11] Zhang, J., Athalye, R., Hart, R., Rosenberg, M., Xie, Y., & Goel, S. et al. (2013). Energy and Energy Cost Savings Analysis of the IECC for Commercial Buildings. Richland: Pacific Northwest National Laboratory. Retrieved from https://www.energycodes.gov/sites/default/files/documents/PNNL-22760.pdf

[12] Zhang, J., Athalye, R., Hart, R., Rosenberg, M., Xie, Y., Liu, B., & Zhuge, J. (2015). Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings. Richland: Pacific Northwest National Laboratory. Retrieved from https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24269.pdf

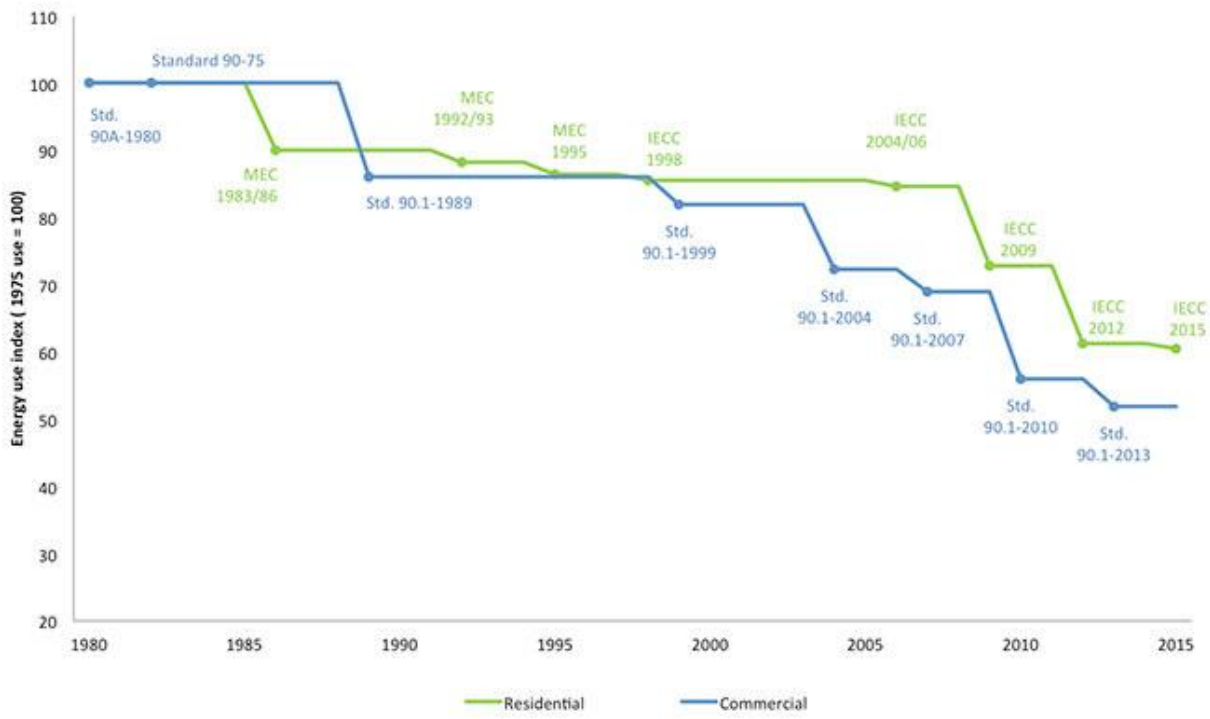
[13] U.S. Department of Energy (2017). Energy Savings Analysis; ANSI/ASHRAE/IES Standard 90.1-2016. https://www.energycodes.gov/sites/default/files/documents/02222018_Standard_90.1-2016_Determination_TSD.pdf

[14] Liu, B., Zhang, J., Chen, Y., Edelson, J., & Lyles, M. (2018). Energy Savings Analysis of the Proposed NYStretch-Energy Code 2018. doi: 10.2172/1418063 https://www.osti.gov/servlets/purl/1418063

[15] Per communication with the New Buildings Insitutute

Energy Codes have improved dramatically over time, with the energy use of a new building today being approximately half that of a building built to the 1980 code, as shown in Figure 1 from the American Council for an Energy-Efficient Economy.[16]

Figure 1: Improvements in Model Energy Codes, 1980-2015



IECC 2015 and ASHRAE 90.1-2013 are in line with this trajectory. Because LEED v4 is keyed off the older standard (90.1-2010), a commercial building built to the new Virginia code will automatically achieve LEED points—this should be considered when setting new standards, as shown in Table 5. This table also shows our assumptions for the percent of energy use originating from electricity vs. natural gas, which is critical for calculating greenhouse gas emissions. LEED v4.1 is keyed off 90.1-2016, and so would not award points for code compliance.

[16] Ungar, L. (2016). Take a ride on the energy slide with building codes. Retrieved from https://aceee.org/blog/2016/02/take-ride-energy-slide-building-codes

Table 5: LEED Points by Compliance with the Energy Code, with Assumed Gas/Electric Breakdown

Building Type	Average EUI in 4A under LEED v4 baseline (90.1-2010) (kBtu/ft2)	Average EUI under new IECC 2015 / 90.1-2013 code (kBtu/ft2)	% improvement of new code over 90.1-2010	LEED v4 points for achieving code compliance	Assumed % electric[17]	Assumed % Gas[18]
Multifamily	53.0	50.7	4%	0	100%	0%
Commercial (all)	59.2	54.6	8%	2	85%	15%
Office	71.4	59.6	17%	6	100%	0%
School	44.4	36.6	17%	6	85%	15%
Retail	57.2	46.9	18%	7	85%	15%
Hotel	91.2	70.2	23%	9	66%	34%

We used these findings to help set ambitious but achievable targets for new construction and to model the energy and GHG impacts of such a policy, which are discussed in sections 6.1.1 and 6.1.2. To project impacts, we used the following numbers for building floor area in Alexandria. Projects currently in development will not be subject to the new policy. Therefore, the proposed policy was modeled using the growth forecast in the City's Small Area Plans (SAPs). The estimated growth for the SAP zones is based on the City's estimate of how these plans will develop at the time of this report. The calculated impacts of the current and new policy are summarized in section 6.1.6 and discussed in detail in Appendix C.

Table 6: Existing and Anticipated Building Floor Area by Sector

Building Type	Existing Gross Floor Area (ft^2)	Gross Floor Area In development (ft^2)	Estimated Gross Floor Area Anticipated in Small Area Plans (ft^2)
Public Municipal	2.5 million	Under Review[19]	0.4 million[20]
Multifamily Residential	61.9 million	6.8 million	30.1 million
Office	21.8 million	1.7 million	15.7 million
Retail	11.4 million	362,000	4.4 million
Hotel	2.7 million	217,000	1.3 million
Other Commercial	1.9 million	317,000	0.7 million

[17] Based on comparison using Washington, DC, data for office and multifamily; PNNL data for other building types.
[18] Based on comparison using Washington, DC, data for office and multifamily; PNNL data for other building types.
[19] Under review by the City at the time of publication.
[20] This is an estimate based on assuming that planned municipal buildings within Small Area Plan zones are the same size as existing typical City of Alexandria buildings of the same building type. Based on a review of the existing city portfolio, we assumed that new fire stations are 13,000 ft^2, new recreation centers and community buildings are 15,000-20,000 ft^2, and new offices and civic buildings are 50,000 ft^2.

5.4 Green Building Rating Systems: Equivalency Overview

Alexandria's current Green Building Policy requires the use of LEED or an equivalent standard. Table 7 contains an overview comparing a selection of green building standards. The information and charts below are derived in part from a U.S. Department of Energy study conducted for the U.S. General Services Administration comparing LEED, Green Globes, and the Living Building Challenge.[21] We also reviewed the Earthcraft and National Green Building Standard (NGBS), which have both been used in Alexandria, and Enterprise Green Communities, another standard commonly used in the regional market. While several rating systems have multiple typologies, this report focuses on the typologies applicable to new, large buildings, of the types that are subject to a DSP/DSUP.

Table 7: Highlights of Reviewed Rating Systems

Standard	Typologies	Performance Areas	Levels of Certification	Reviewed Version
LEED[22,23]	**BD+C (New Construction and Major Renovation)**, O+M (Existing Buildings Operations and Maintenance), HOMES (Single Family), ID+C (Interior Design and Construction), LEED-ND (Neighborhood Development), LEED Zero (a new zero-carbon certification available to BD+C and O+M projects)	Sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality	Certified, Silver, Gold, Platinum	4.0 & 4.1
Green Globes[24]	**NC (New Construction),** EB (Existing Buildings), Sustainable Interiors (SI)	Energy, indoor environment, site, water, resources, emissions, and project/ environmental management	One, two, three, or four globes	2018

[21] Wang, N., K.M. Fowler, and R.S. Sullivan. (2012). "Green Building Certification Review." *U.S. Department of Energy, for the General Services Administration.* https://www.gsa.gov/cdnstatic/GBCS2012_Cert_Sys_Review.pdf
[22] U.S. Green Building Council. LEED v4 for Building Design and Construction. Washington, DC. Retrieved from https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version
[23] U.S. Green Building Council. LEED v4.1 BD+C https://new.usgbc.org/leed-v41#bdc
[24] Green Building Initiative, Inc. (2018). Green Globes for New Construction. Green Building Initiative, Inc. Retrieved from https://www.thegbi.org/files/training_resources/Green_Globes_NC_Technical_Reference_Manual.pdf

Standard	Typologies	Performance Areas	Levels of Certification	Reviewed Version
Living Building Challenge[25]	**Building**, Renovation, Landscape or Infrastructure, **Neighborhood/ Community**	Site, water, energy, health, materials, equity and beauty	"Living Building Petal Certification" also available for projects that only meet the requirements in 3+ areas (one of which must be energy, water, or materials)	N/A
Enterprise Green Communities[26]	**Multifamily**	Integrative Design, Location + Neighborhood Fabric, Site Improvements, Water Conservation, Energy Efficiency, Materials, Healthy Living Environment, Operations + Maintenance + Resident Engagement	One level	2015
Earthcraft[27]	Single Family, **Multifamily**, Renovation, Communities, and Sustainable Preservation	Site Planning, Construction Waste Management, Resource Efficiency, Durability, High Performance Envelope, Energy Efficiency, Water Efficiency, Education and Operations	Certified, Gold, Platinum	2016
ICC 700 / National Green Building Standard (NGBS)[28]	Single-Family, Multifamily, Remodeling, and Land Development	Site Design and Development, Lot Design and Development, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality, Operation and Maintenance	Bronze, Silver, Gold, Emerald	2015

[25] Living Building Challenge: https://living-future.org/lbc/resources/
[26] Enterprise Green Communities. (2015). 2015 Enterprise Green Communities Criteria. Washington, DC: Enterprise Green Community Partners, Inc. Retrieved from https://www.enterprisecommunity.org/sites/default/files/media-library/financing-and-development/grants/2015-green-criteria-2015-2-11.pdf
[27] Viridiant. (2016). EarthCraft Multifamily Guidelines, V5. Richmond, VA. Retrieved from https://www.viridiant.org/wp-content/uploads/2016/02/ECMF-Technical-Guidelines.pdf
[28] ICC 700-2015 National Green Building Standard. *National Association of Homebuilders.* https://www.nahb.org/en/nahb-priorities/green-building-remodeling-and-development/icc-700-national-green-building-standard.aspx

Key Differences between Rating Systems:

- Unlike LEED, Green Globes has no prerequisite requirements; thus, an examination of the points achieved on each individual project would be required to determine which requirements would be met by certification and be considered to be equivalent to LEED certification.
- LEED has minimum requirements that must be met before any level of certification can be attained (called prerequisites). The prerequisites do not add to the total number of points needed to achieve certification.
- The Living Building Challenge exceeds requirements set by any other standard. Unlike the other standards, LBC uses absolute, Net Zero metrics, and so the minimum performance does not change with new versions.
- Green Globes, Living Building Challenge, and Earthcraft (for just energy) use on-site auditors to augment the certification information received electronically, while LEED bases its certification solely on the information submitted electronically.
- LEED requires that new construction projects submit measured energy and water performance to the USGBC five years after certification. The Living Building Challenge is designed to incorporate the results of at least the first year of a building's operations prior to certification, which means this system has the greatest emphasis on measured performance.
- Enterprise Green Communities is only available to multifamily properties.
- Earthcraft serves both single family and multifamily projects. Earthcraft is historically rooted in Virginia, and is the standard commonly used—but not required—for affordable housing development projects in Virginia.
- NGBS is primarily designed for and used for single-family homes and multifamily projects.
- The best LEED comparison for the use of NGBS and Earthcraft in the single-family sector is LEED HOMES. However, as the scope of this work was to focus mostly on larger buildings, a detailed examination of the single-family use case, and standards specific to it, was not within scope.

Because of the different approaches each standard takes, it is challenging to provide guidance on how to achieve true equivalency amongst the various standards. However, it is possible to mandate similar performance for specific building elements, including energy/GHG emissions, water, and stormwater. If Alexandria is to allow projects to certify through an "equivalent standards" provision, we recommend that regardless of the rating system, all buildings meet the same energy, GHG, water efficiency, and stormwater management targets suggested as an overlay to LEED certification in this document. This allows a true apples-to-apples comparison for the elements that Alexandria has identified as most important in their Environmental Action Plan.

For convenience, we have reviewed the other standards listed above and identified what the "equivalent" achievement in their standard would be, if it exists. In some cases, equivalency is possible but may require some additional work on the part of the City to verify the project's intent to meet a given performance target.

LEED should remain the default green building standard. We recommend that all projects subject to the Green Building Policy, including multifamily projects, meet the LEED Silver standard, or an equivalent

standard. However, because of state level guidance on affordable housing, we recommend that Alexandria allow the use of Earthcraft for affordable housing projects.

If the City determines that it will also allow certification through an "equivalent standard," we recommend that the City work with the standard organization(s) to create an Alexandria specific platform that would include the equivalent amount of points or credits to typical LEED Silver (private) or LEED Gold (public) certification. This will be particularly important given that Green Globes, Enterprise Green Communities, and NGBS are all actively working on updates to their standards, but those updates were not available for public review during the timeframe of this project.

The following are additional specific notes on each standard:

- **The Living Building Challenge** exceeds all requirements and should be accepted and actively promoted as an alternative compliance path, as it represents the highest available certification standard in the marketplace.
- **Living Building Petal** Certification is available is also available for projects that only meet the requirements in 3 or more areas (one of which must be energy, water, or materials). To align with Alexandria's environmental goals, Living Building Petal Certification would be acceptable for compliance if the building achieved both the energy and water petals.
- **Enterprise Green Communities** could be considered if equivalent performance criteria and points are met or exceeded. Under the current version of Enterprise, the City will need to independently verify water use reduction targets, as the maximum points in Enterprise currently fall short of the recommended target.
- **Green Globes** could be considered as an alternate compliance path, provided the applicant achieves a minimum of two Green Globes, plus equivalent energy and water performance as the targets described in this document. Because there are no prerequisites in Green Globes, however, we recommend that the City work with Green Globes to provide compliance checklists and guides to ensure that properties pursing Green Globes meet all of the City goals in addition to the energy and water targets. The City may need to undertake staff review and verification for areas where the related topic under Green Globes does not neatly align with the City's performance threshold. We recommend that the City work with GBI to create an overlay document and calculator that guides project teams in how to meet Alexandria's targets within the Green Globes framework.
- **Earthcraft** could be considered as an alternative compliance path, provided the applicant achieves at least a Gold rating, plus equivalent energy and water performance to the targets described in this document. For the renewable energy, indoor water use reduction, and outdoor water use reduction areas, the City may need to undertake staff review and verification because the City's targets do not map exactly onto existing Earthcraft points. We recommend that the City work with Viridiant to create an overlay document and calculator that guides project teams in how to meet Alexandria's targets within the Earthcraft framework.

  Additionally, we recognize that Earthcraft may need to remain an option at the certified level for some affordable housing properties. The City's Office of Housing allows Earthcraft standards for affordable housing projects, subject to VHDA requirements, and the Earthcraft standard has

strong roots and market penetration in Virginia. Because of the strict cost caps for affordable housing developments in Virginia, the City could opt to allow a lower level of Earthcraft for affordable housing projects. This would minimize market disruption for affordable housing projects.

- **ICC 700 / National Green Building Standard** does not take a performance-based approach to most of the key metrics evaluated for this report; as with Green Globes and Earthcraft, it could be considered an alternative compliance path so long as the Silver level is achieved, and the performance targets are met. The City might need to undertake additional staff review and verification for places where there is not an equivalency for the City's targets within the NGBS standard. The ENERGY STAR Residential New Construction standard may be able to be used as an alternate verification method for the energy performance of NGBS projects, as it requires buildings to achieve energy use intensity reductions of 15% below the state code (where that code exceeds 90.1-2010, as is the case in Virginia).[29]

Exemptions

The current Green Building Policy does not have an exemption process. However, if the requirements are increased as proposed, there may be some limited situations where an exemption should be considered (for example if a building does not have available solar insolation or space to meet the solar requirement). The City could form a Green Building Advisory Council (GBAC) similar to the one used in the District of Columbia to help advise on possible exemptions. The GBAC in DC advises the DC Department of Energy and Environment on exemption requests and helps hold developers accountable. The GBAC can also request studies to demonstrate infeasibility or recommend alternate options. Since its creation by the Green Building Act of 2006, the GBAC has reviewed relatively few requests for exemptions, but in almost all cases has been able to work with the developer to find a way for the property to get the required certification and come into compliance.[30]

For example, if an affordable housing project cannot meet the energy and water targets recommended in this report while also staying within the state's cost cap and remaining competitive for important tax credits, the City could consider offering that project an exemption. Exemptions should require the completion of a study detailing why the performance design targets cannot be met. Additionally, while human health is not currently being recommended as a design target for private building projects, because of the importance of improving health outcomes in affordable housing, the City could consider allowing affordable housing properties to meet the health standards that are recommended for public buildings as an alternate path if the energy targets are not achievable.

[29] Ibid.

[30] For more information, see: Department of Energy and Environment, "Green Building," *Government of the District of Columbia*, https://doee.dc.gov/node/23552 Accessed February 13, 2018.

6. Findings and Analysis

6.1 Strategy A: New Construction Standards and Directed Use

EAP Actions 3.1.a and 3.1.d: "Increase LEED or equivalent third-party green building certification standards for private development" and "prioritize specific green building elements" in private development projects.[31]

We recommend that private projects, both commercial and residential, achieve LEED Silver as a minimum, or an equivalent standard.[32] This will raise the bar for multifamily properties while ensuring a level playing field between commercial, multifamily, and mixed-use property types. It also puts Alexandria's policy more in line with peer jurisdictions, as discussed in Appendix A.

In addition, projects should be designed to meet the performance criteria listed below. The setting of specific performance targets in addition to LEED is a growing best practice, as shown in Appendix A. The suggested performance design targets will provide clarity and consistency over time, even as green building standards are updated. These are the key recommendations and form the heart of the policy.

To ensure the policy achieves its aims, it will also be important that Alexandria collect data on the actual performance outcomes post construction and occupancy. There is often a large gap between designed performance and actual operation outcomes—monitoring this difference is the first step to addressing it. Putting in place a performance monitoring program will position Alexandria in line with leading jurisdictions and the cutting-edge of green building standards, including LEED 4.1. This element of the policy, which may be appropriate for EAP Phase 2, is provided in section 6.1.5.

For ease of communication and enforcement, LEED v4 and v4.1 credit equivalencies are provided for each of the design targets. Requiring LEED plus these credits is referred to as "directed use." However, the LEED target is just an easy way to check the performance target—it is the performance targets that would form the basis of the enduring policy, as standards change. The equivalent performance target for the other rating systems is also provided, if they existed. In some cases where an equivalent target did not exist, the consultant worked with the City and the certification organizations to propose an alternate compliance option. All equivalencies are only accurate for the current version at the time of publication. For example, the new Enterprise Green Communities and Green Globes standards are under development. As these standards are updated, the City could work directly with the to determine what the updated credit equivalence for directed use should be.

The current Green Building Policy is applied to projects that are subject to Development Site Plan (DSP) review or Development Special Use Permit (DSUP) review. These recommendations are designed to apply to both new construction and major renovations.[33] They are also designed to apply to major conversions of one building type to another, if they are subject to the DSP or DSUP process. The City will

[31] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25.
[32] As noted above, equivalent standards include Living Building Challenge, Living Building Energy & Water Petals, Enterprise Green Communities, two or more Green Globes, and Earthcraft Gold, provided that the performance targets outlined in the following pages are also met.
[33] The threshold for a "major renovation" may be beneficial for the City to define. In the District of Columbia, it means a project exceeding 50% of the building value; ICC uses a similar concept of a "substantial improvement."

determine if an additional threshold is needed for conversion projects; however, the work needed to convert from an office to a multifamily building, for instance, is likely to qualify as a major renovation.

6.1.1 Energy Use

Energy targets are listed in Table 8. The calculations that informed the energy targets are included in Appendix C.

Table 8: Recommendations and Equivalencies for Energy Use in Private Building Projects

Past Performance	Performance Design Target	LEED equivalence	Other Equivalence
Optimize Energy Performance[34]: LEED v2009 measured savings against a baseline of ASHRAE 90.1-2007. The average achievement in Alexandria for LEED v2009 projects was 8 points, or 26% reduction vs. 90.1-2007. 3 projects <20% reduction 4 projects 20%-30% reduction 3 projects >40% reduction	**EUI targets:** < 35 kBTU/ft^2 for multifamily residential buildings < 45 kBTU/ft^2 for commercial (with exceptions for hospitals, food service, and industry) < 30 kBTU/ft^2 for schools No specific EUI target for hospitals, food service, or other energy intensive industries, but a similar improvement over baseline is still expected (e.g. >15-25% better than baseline/code). This equates to: • >30% reduction relative to 90.1-2010 for both commercial and residential • 18-25% improvement over VA energy code (90.1-2013) for commercial • 15-30% improvement over VA energy code (90.1-2013) for residential • 18-24% improvement over 90.1-2016	LEED v4 EA Optimize Energy Performance (p. 74-75): Minimum 12 points. *12 points are awarded for the following energy cost reductions relative to a 90.1-2010 baseline:* • *>29% EUI reduction for New Construction (non-healthcare)* • *>27% EUI reduction for major renovations (non-healthcare)* • *>26% reduction for Core and Shell* • *>22-24% EUI reduction for healthcare* LEED v4.1 EA Optimize Energy Performance: Minimum 4 points. *4 points are awarded for the following Performance Cost Index (PCI) Reductions relative to a 90.1-2016 baseline:* • *>24% EUI reduction for New Construction (non-healthcare)* • *>16% EUI reduction for major renovations, Healthcare, and Core and Shell*	✓ Living Building Challenge or Living Building Energy Petal: Minimum requirements exceed target. ✓ Green Globes: 60 points for Energy Performance, or for Multifamily projects, the forthcoming "Multifamily Performance Plus" certification. ✓ Enterprise Green Communities: The full 12 points in criteria 5.2. × Earthcraft: Certify at the Gold level. This requires a HERS score of 75 or less (lower is better), According to a review of Earthcraft units certified in 2016-2017, less than 1% of those with HERS ratings over above 75 had an EUI of more than the recommended multifamily maximum EUI of 35 kBTU/ft2.[35] Additionally, these EUIs appear durable over time.[36] × NGBS: By default, NGBS does not take a whole building performance approach. An alternate solution could be requiring a building certified under NGBS to also get certified

[34]LEED v4 offers points based on % reduction relative to 90.1-2010. The new Virginia energy code is based on IECC 2015 / ASHRAE 90.1-2013. According to PNNL, this means meeting the baseline Virginia energy code could net the a commercial building 7 points under LEED v4. No similar benefit is available under 4.1, as it is based on 90.1-2016.
[35] Viridiant, (2019). "Comparison of the EarthCraft Multifamily Program to the Objectives of the City of Alexandria Green Building Policy: Final Technical Report." Provided by Viridiant to the City on April 5, 2019.
[36] McCoy, A. Zhao, D., Agee, P., Mo, Y., & F. Paige. (2017). "Sustaining Energy Efficiency: Longitudinal Evidence of Virginia's Low-Income Housing Tax Credit Properties." A Report by the Virginia Center for Housing Research (VCHR) at Virginia Tech for Housing Virginia. August 29, 2017.

Past Performance	Performance Design Target	LEED equivalence	Other Equivalence
			under ENERGY STAR for Residential New Construction. The ENERGY STAR NC program requires that buildings exceed the local energy code by 15% (when that code is more recent than 90.1-2010, as it is in Virginia.)[37]
Onsite Renewable Energy One project achieved 13% onsite renewable energy. The remainder achieved 0%	Buildings subject to DSUP should be designed to have at least 5% of their total site energy be supplied by onsite renewable energy	LEED v4 Onsite Renewable Energy 1 point = 1% of total energy cost supplied by on-site renewable energy 2 points = 5% of total energy cost supplied by renewable 3 points = 10% of total energy cost supplied by renewable LEED v4.1 Onsite Renewable Energy also provides points for offsite renewable energy. If Alexandria wishes to ensure that DSUP projects have on-site renewables, additional verification will be required.	✓ Living Building Challenge or Living Building Energy Petal: Minimum requirements exceed target. ✓ Enterprise Green Communities: 6 points in criteria 5.7b for 5% of total energy demand being met with onsite PV for buildings 4 stories or more, and 10% for buildings 2-3 stories ? Earthcraft: This may require independent verification by City. IN 1.3 awards optional points for the installation of solar capacity sufficient to offset 10% of electric load, so a building that achieves IN 1.3 will be deemed compliant. However, there are no credits for installing solar capacity of more than 0% but less than than 10% of the load; therefore the compliance of such buildings will require verification. × Green Globes: RE would require independent verification by City. Green Globes currently awards points for conducting a feasibility study and then implementing its recommendation, but the points are the same regardless of the level of RE installed. × NGBS: Renewable energy only discussed as third-party service,

[37] U.S. EPA ENERGY STAR. ENERGY STAR Residential New Construction program. https://www.energystar.gov/newhomes/homes_prog_reqs/multifamily_national_page#site-built.

Past Performance	Performance Design Target	LEED equivalence	Other Equivalence
			which is not applicable for all customers in Virginia.
Enhanced Commissioning 5/10 LEED 2009 projects achieved this credit. Most earlier projects achieved the credit.	Achieve a minimum 3 points Enhanced Commissioning under LEED V4	LEED v4 & v4.1: Enhanced Commissioning, 3 points	✓ Living Building Challenge or Living Building Energy Petal: Mandatory ✓ Enterprise Green Communities: Mandatory ✓ Green Globes: Achieve full points for each aspect of Whole Building Commissioning, unless one or more of the listed items is not applicable. ✓ Earthcraft: Gold certification requires all projects to "High Rise Addendum" level of commissioning: this will ensure commissioning of most major building systems equivalent to the intent of the performance target. × NGBS: Not discussed
Measurement & Verification / Metering 5/10 LEED 2009 projects achieved the Measurement & Verification credit.	Advanced Energy Metering for the whole building and any end uses making up over 10% of the building load. In addition, Alexandria should work with private entities that that are deploying building management systems and energy data visualization to develop pilot programs that help building owners recognize the value of this metering investment.	LEED v4 & v4.1: Advanced Energy Metering, 1 point	✓ Living Building Challenge or Living Building Energy Petal: Mandatory ✓ Enterprise Green Communities: Mandatory, Criteria 5.6 ✓ NGBS: Achieve points under 705.7 for submetering, and 706.1 for smart thermostats ✓ Green Globes: Achieve full points for whole building metering of applicable systems, and at least 50% of points under sub-metering ? Earthcraft: Does not specifically address sub-metering of loads. One option would be to require that projects achieve full points under IN 1.7 for energy monitoring, which requires the tracking of energy usage for 12 months following project completion, and the sharing of that data.

6.1.2 Water Efficiency

Table 9: Recommendations and Equivalencies for Water Efficiency in Private Building Projects

Past Performance	Suggested Target	LEED equivalence	Other Equivalence
Water Use Reduction LEED 2009 AVERAGE 16% reduction over baseline 5 projects achieved 0% 5 projects achieved 30-35%	**Indoor water use reduction** Minimum 40% better than baseline	LEED v4 & 4.1 WEc2 Indoor Water Use Reduction: Minimum 4 points or 40% better than baseline (see Table 10 below).	✓ Living Building Challenge or Living Building Water Petal: Minimum requirements exceed target ✓ Green Globes: 24 points in Water Consumption 3.4.1 ✓ Enterprise Green Communities: Currently would need City verification, as Maximum points are awarded only 30% reduction over baseline, but this is likely to be revised × Earthcraft: Achieving the Gold level of certification and full points under WE 1.5 only yields a 35% level of water savings relative to the baseline. To ease compliance, the City could work with Earthcraft to create a calculator that multifamily project teams could use to demonstrate compliance with the 40% reduction for residential spaces. × NGBS: No performance criteria
Water Efficient Landscaping LEED 2009 AVERAGE 80% reduction in potable water use	**Outdoor water use reduction** Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period. OR 50% reduction in landscape water requirement from the calculated baseline for the site's peak watering month.	LEED v4 & v4.1 WEc1 Outdoor Water Use reduction **Option 1. No Irrigation Required (2 points)** Show that the landscape does not require a permanent irrigation system OR **Option 2. Reduced Irrigation (1 point)** Reduce the project's landscape water requirement by at least 50% from the calculated baseline for the site's peak watering month.	✓ Living Building Challenge or Living Building Water Petal: Minimum requirements exceed target ✓ Enterprise Green Communities: 8 points in Criteria 3.5b for 50% reduction in irrigation water use ✓ Green Globes: At least 11 points in Irrigation section 3.4.8.1, for 50%+ reduction in vegetated space needed permanent irrigation. × Earthcraft: Minimal requirements around outdoor water use. The City could work with Earthcraft to have projects calculate their outdoor water use reductions and demonstrate compliance. × NGBS: No performance criteria

Table 10: LEED v4 Baseline Flow Rates[38]

Fixture or fitting	Baseline (IP units)	Basline (SI units)
Toilet	1.6 gpf	6 lpf
Urinal	1 gpf	3.8 lpf
Public lavatory faucet	0.5 gpm at 60 psi	1.9 lpm at 415 kPa
Private lavatory faucet	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Showerhead	2.5 gpm at 80 psi per shower	9.5 lpm at 550 kPa per shower

6.1.3 Stormwater Management

In 2014, the City of Alexandria updated its stormwater requirements for development and redevelopment projects to comply with Virginia Stormwater Management Program (VSMP) regulations. During this update, the City made the decision to keep its additional existing requirement for treatment of the water quality volume default (WQVD), which requires treatment of the first ½ inch of rainfall over the entire impervious area. This resulted in a stormwater treatment requirement that is more restrictive than those required by the VSMP regulations and other jurisdictions in the State.

In addition, in April 2018, the City of Alexandria introduced new, additional stormwater management requirements for all new development. These new requirements ratchet up the environmental performance expected of new development above what was being achieved under the existing Green Building Policy. New development in Alexandria must meet the following additional requirements:[39]

- "A minimum of 65% of total phosphorus (TP) removal required by the Virginia Stormwater Management Program (VSMP) must be achieved using non-proprietary surface BMPs approved by the Virginia Stormwater BMP Clearinghouse.
- A maximum of 25% of the TP removal required by the VSMP may be achieved using [Manufactured Treatment Devices] MTDs and/or sand filters approved by the Virginia Stormwater BMP Clearinghouse.
- Any Approved BMP may be used to meet the balance of the Alexandria Water Quality Volume Default (WQVD).
- MTDs may not be used on single-family detached residential projects."

Virginia law requires the management and treatment of the rainfall to meet specific pollution reductions, in addition to requiring that runoff rates cannot exceed pre-development levels. These new requirements, in practice, require that 65% of that rainfall be treated for nutrient removal using green infrastructure. The City's 2018 stormwater requirements were developed in close cooperation with private industry, and to change them less than a year later would be disruptive. After discussions with the City, we are not recommending any further increase in the required Stormwater practices for private development. However, new public development requirements are recommended below.

[38] U.S. Green Building Council. (2019). LEED v4 for Building Design and Construction. Washington, DC. Retrieved from https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version
[39] City of Alexandria. (2018). Memorandum to Industry No 01-18. Alexandria: City of Alexandria

6.1.4 Human Health

Human Health is a growing area of importance for green building policy. One notable study compared green vs. conventional multifamily buildings and single-family homes in South Boston. Comparing new LEED Platinum buildings to new, code-compliant, conventional buildings, they "observed 57%, 65%, and 93% lower concentrations of PM2.5, NO2, and nicotine (respectively) in green vs control homes…as well as fewer reports of mold, pests, inadequate ventilation, and stuffiness. Participants in green homes experienced 47% fewer sick building syndrome symptoms ($p < 0.010$)." The researchers also observed "significant decreases in multiple indoor exposures and improved health outcomes among participants who moved into green housing, suggesting multilevel housing interventions have the potential to improve long-term resident health."[40]

In the public building section of this report, we propose specific human health targets for schools and other government buildings. However, as the study above notes, there are significant benefits for prioritizing human health in private buildings—particularly in affordable housing. At a minimum, Alexandria could consider requiring new buildings subject to a DSP or DSUP to, as a baseline, meet the SCAQMD requirements for Low/No VOCs, as specified in ASHRAE 189.1, for all interior paints, coatings, adhesives, and sealants.[41] There exist cost effective options for low- and no-VOC products in all these categories. A fuller set of recommendations for health promotion in public buildings is provided below in Section 6.2

6.1.5 Performance Monitoring

The targets discussed in section 6.1 are design targets. We recognize there is often a substantial gap between design and actual outcomes. A performance monitoring program can help close this gap. Over the past decade, the focus of green building certification has shifted from design intent to operational outcomes. In parallel, new technology is emerging that makes it much cheaper and easier to track, analyze, and compare operational performance. More jurisdictions are now trying to regularly collect data on buildings after they are built to ensure that the achieved performance matches the original targets.

For future phases of the EAP, Alexandria would be well served by implementing a program to regularly track existing building performance as compared to design intent. It is a reasonable and practical expectation for every green building in the City of Alexandria to design for performance and, in turn, measure operational performance and share it with the City. This ensures accountability and provides the basis for the City to improve policy outcomes over time. Projects should commit to measuring their green building outcomes—particularly energy use and water use—on an ongoing basis using existing free and low-cost tools. They should further commit to sharing those outcomes with the City. Several standards, including LEED 4.1 O+M and ENERGY STAR for Existing Multifamily Buildings, integrate

[40] Colton, M., et. al. 2014. "Indoor Air Quality in Green Vs Conventional Multifamily Low-Income Housing" Environ. Sci. Technol., 48 (14), pp 7833–7841

[41] South Coast Air Quality Management District. Rule 1113. Architectural Coatings (2016). http://www.aqmd.gov/home/rules-compliance/compliance/vocs/architectural-coatings Accessed February 13, 2019.

ongoing monitoring into the core of the program. Other standards may offer optional points for performance monitoring; for example, Earthcraft offers points for this under IN 1.7.

All commercial and multifamily projects could use U.S. EPA's ENERGY STAR Portfolio Manager, which is less granular but also more user friendly. As discussed below, local governments in Virginia cannot yet require ENERGY STAR benchmarking for all private buildings, but Alexandria could require new projects applying for development approval to agree to share benchmarking data with the City on an ongoing basis. We would suggest that this sharing be done via the tool's built-in sharing functionality and/or via web services (rather than a reporting template) so that the City gets data on a monthly basis and there are no transaction costs for building owners.[42] We further suggest that when properties are using the ARC tool developed by USGBC, they share that data with the city as well, since it will be more detailed and closer to real-time than the ENERGY STAR benchmarking data. Projects registering with LEED 4.1 can use the ARC tool to track and share granular data with building occupants, stakeholders, and City staff at no cost.[43] (Projects registered under older versions of LEED or other standards can also use ARC, but must pay for the service.)

6.1.6 Projected Environmental Impacts

6.1.6.1 Energy and GHG Impacts:

To calculate impacts, specific average EUIs were generated under both the business as usual and policy scenario cases for multifamily buildings, office buildings, hotels, retail buildings, schools, and miscellaneous commercial buildings. The business as usual scenario assumes that all new growth forecast in the area plans would achieve the energy performance specified in the new Virginia Energy Code, based on IECC 2015 and ASHRAE 90.1-2013.

The different building sectors were then modeled as achieving an average of a 30% reduction in EUI relative to 90.1-2010, per the LEED v4 Optimize Energy Performance target recommended above. EUIs were split between electricity and gas based on current regional construction norms as identified in PNNL modeling for the District of Columbia and New York City. GHGs from electricity were based on the 2016 EPA eGRID GHG intensity for the Virginia-North Carolina sub region. Natural gas GHG intensity used a flat national average that does not account for fugitive emissions.

The new EUI and energy performance targets will reduce the EUI of new buildings by between 18% and 33% depending on building type relative to the code and reduce the total energy use of the buildings forecast in the small area plans by 20%, or 592 billion BTU per year. The targets will reduce the GHGs from these buildings by more than 63,000 metric tons per year; also 20% less than the BAU case. Compared to the current GHG emissions of Alexandria as a whole, and a BAU case where GHGs increase due to new construction but transportation emissions stay flat, these targets will reduce citywide GHG emissions by more than 3%.

While this number does not seem significant at first glance, this is in line with the GHG savings for new construction policies in other jurisdictions. To take a particularly aggressive example, strategies for new

[42] [42] Share and request data. (2019). Retrieved from https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/share-and-request-dataAccessed February 14, 2018.
[43] Arc Skoru | Sustainability performance platform. (2019). Retrieved from https://arcskoru.com/

construction included in the District of Columbia Clean Energy DC Plan are forecast to reduce citywide GHGs by 4.6% relative to BAU. This is a similar order of magnitude as the savings forecast for Alexandria, but it is ~50% more impactful because DC controls its own energy code and is aiming for a net zero energy code by 2026, with EUI reductions ranging from 65% to 80% depending on building type.

To truly meet the overall greenhouse gas reduction goals established in the EAP, Alexandria will need assistance from the Commonwealth and the utility companies to target existing buildings with a suite of policies to reduce energy use, to dramatically increase renewable energy supply in Virginia, and to transition residents to electric vehicles, among other action areas.

The use of Performance Monitoring will enable the City to track these impacts over time, and may also make the impacts deeper and more durable, as building owners and operators are able to monitor and respond to performance issues.

A full discussion of the energy and GHG impacts of the energy standards is discussed in Appendix C, including all calculations and results.

6.1.6.2 Water Impacts:

To calculate water impacts, we looked at the average water use intensities (WUI) for major building types nationally, measured in gallons per square foot per year.[44] Unlike with energy use or greenhouse gas emissions, these values do not vary significantly by geography or climate zone. The average energy use improvement over baseline achieved by buildings built under Alexandria's existing policy is 16% (see Appendix B). Our recommendation is that new buildings subject to the policy reduce their indoor water use by 40% relative to baseline. When applied across the forecast new floor area, this will avoid the use of at least 421 million gallons of water a year, or a 29% reduction in water use from new construction, relative to business as usual.

Citywide water consumption figures were not available at the time of this report. However, if we assume that the multifamily and commercial buildings in Alexandria use water at the same rate as nationally, on average, then we can estimate that multifamily and commercial buildings in Alexandria currently use at least 3.3 billion gallons of water a year, and that the new policy will reduce the total water used by the multifamily and commercial sectors in Alexandria by 9% relative to BAU.

These water savings estimates are underestimates, because they only account for reductions in indoor water use. The policy also has standards for reducing outdoor water use for irrigation. However, as reliable national metrics for irrigation water use were not available, the savings from these irrigation limits could not be calculated.

A full discussion of the water use impacts of the water standards is discussed in Appendix C, including all calculations and results.

[44] 2012 Commercial Buildings Energy Consumption Survey: Water Consumption in Large Buildings Summary. (2017). Retrieved from https://www.eia.gov/consumption/commercial/reports/2012/water/
Fannie Mae. (2014). Transforming Multifamily Housing: Fannie Mae's Green Initiative and Energy Star for Multifamily. Retrieved from https://www.fanniemae.com/content/fact_sheet/energy-star-for-multifamily.pdf

6.2 Strategy B: New and Existing Public Buildings

EAP Action 3.1.b: Establish a separate green building standard for new public development, at a level more ambitious than required for private development and evaluate the feasibility of a net zero standard for new public development, including schools.[45]

6.2.1 New Public Buildings

All public development projects for new construction or major renovation should be (a) certified at the LEED Gold level and (b) aim to achieve net zero energy (NZE) through a combination of energy efficiency and renewable energy systems.

In addition to the above, new construction and major renovation projects for public buildings should meet the following performance requirements:

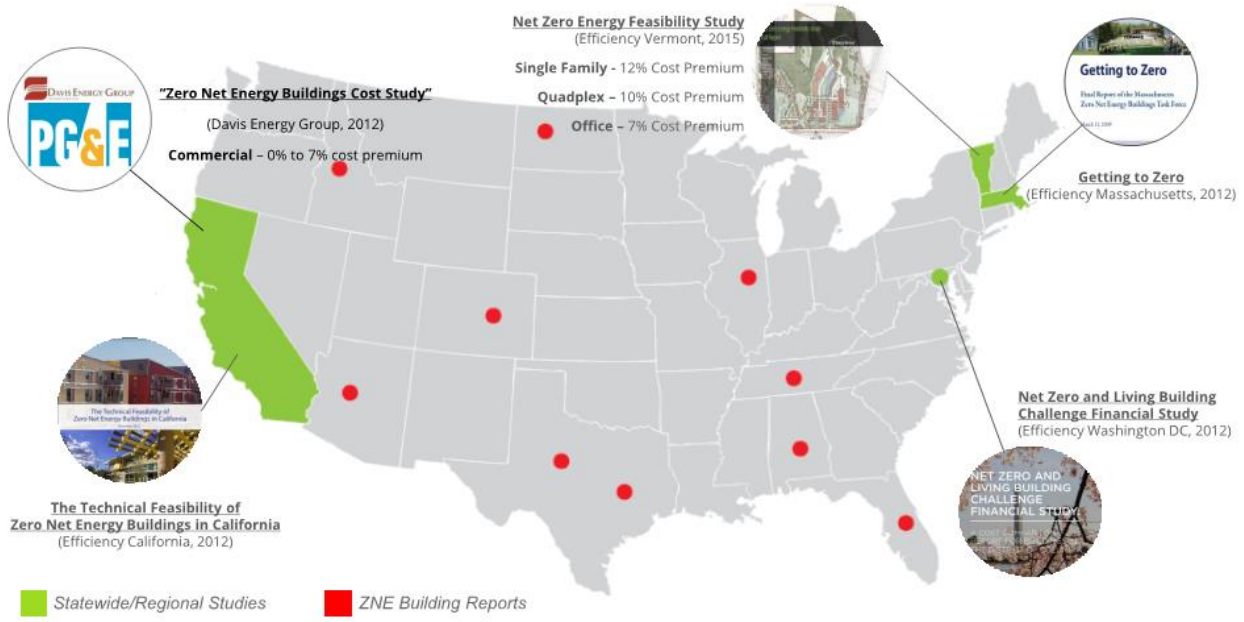
- Reduce indoor water use by 40% relative to the baseline
- Reduce irrigation water use by at least 50% relative to the calculated baseline for peak watering month, and where possible, use plants that require no irrigation with potable water after a maximum two-year establishment period.
- Treat 100% of the required phosphorous removal from stormwater with green infrastructure to reduce phosphorus.
- Use performance-based procurement to deliver higher levels of environmental performance cost-effectively.
- Prioritize human health in new buildings through baselining Indoor Air Quality (IAQ) requirements and including human health early in the project planning process.

6.2.1.1 Net Zero Energy

A net zero energy (NZE) building is a highly energy-efficient building where 100% of the site energy use is met with renewable energy in net over the course of a year, either completely from on-site or a combination of on-site and off-site renewable energy. Most NZE buildings are all-electric (though some supplement with renewable thermal resources), as most NZE certifications do not allow any fuel combustion on site. Designers of NZE buildings should maximize the energy efficiency potential and on-site solar generation potential of the building before supplementing with off-site renewable energy. The Environmental Action Plan target states that the updated Green Building Policy will set forth a path by Fiscal Year (FY) 2020 for new City-owned buildings to meet a net zero standard. Studies have found that net zero energy buildings can be delivered in a cost-effective manner, with first cost premiums for commercial NZE buildings ranging from 0% to 7%, but generally with positive net present values.

[45] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25

Figure 2: Net Zero Energy Studies in the United States



While individual projects always vary, it is generally possible to meet the electricity needs of an NZE building on-site when the building is less than six stories (and/or has substantial additional areas where solar can be established such as on parking canopies), and so long as the building will not contain any particularly energy intensive uses (such as data centers). With tall buildings in dense urban environments, it is often necessary to go off-site for additional renewable energy. By leveraging Power Purchase Agreements (PPAs) for new generation, the building owner can ensure that the renewable energy represents an additional contribution to decarbonizing the electricity grid.

A Power Purchase Agreement is a legal contract between an electricity generator and a power purchaser. For the purposes of this report, we can consider three types of PPAs:

1. PPAs for installation and operation of onsite solar photovoltaic (PV) or other renewable energy
2. A "physical" PPA for the direct purchase of offsite renewable energy on the grid, wherein the buyer signs a contract for the power generated by a specific offsite renewable energy generation and take title to that power
3. A "virtual" PPA, which is a financial instrument wherein the buyer agrees to pay a set price for power, but the actual generated power is sold on the market or to a utility.

Onsite PPAs are available to municipalities in Virginia under enabling legislation that authorizes localities to engage in public-private partnerships. However, the City must pass a local ordinance to activate this authority, which we recommend be a priority for the Council in 2019. This ability will be further supported by the legalization of Municipal Net Metering under legislation passed by the Commonwealth in 2019.[46] Using an onsite PPA, the City could procure renewable power on its own buildings at low cost

[46] H.B. 2792

and could also use additional city properties to support the energy demand of the first NZE buildings. This is could only be done on a small scale, since the City has limited land and building assets but might be an effective way to get the first NZE project or two off the ground while PPA options are still being explored.

The delivery of renewable power under a physical offsite PPA is generally not permissible in Virginia currently (with some minor exceptions that are not applicable to Alexandria). However, virtual or financial PPAs are still permissible for counting towards a NZE certification, provided both energy efficiency and onsite generation potential have been maximized.[47] The City might choose to execute a virtual PPA on its own. Or the City could explore working through the Virginia Energy Purchasing Governmental Association (VEGPA) to pool demand and get a better price. Should the City undertake a project where there is concern about engineering feasibility of NZE, the City could consider installing additional renewable electricity generating capacity on other properties in its portfolio to offset the additional load, or by entering a virtual PPA to purchase off-site renewable electricity. Where a project is believed to not be capable of achieving NZE, we recommend the City ensure a independent feasibility analysis be conducted to verify or offer alternative design and operation considerations to meet the NZE criteria.

For more resources on Net Zero Energy for local governments, see the Getting to Zero Forum's state and local government toolkit.[48]

6.2.1.2 Water

We recommend that public facilities meet or exceed the water efficiency requirements set for private development. In addition, public facilities should lead by example in stormwater management. While private development must meet a minimum of 65% of the required stormwater treatment in green infrastructure, public facilities should meet 100% of the stormwater treatment requirements for the site (where possible) using green infrastructure. This requirement could be waived on a case by case if it is found to be infeasible or not cost effective; however, performance-based procurement may offer the City the ability to meet this goal without adding costs.

6.2.1.3 Human Health

There are two strategies public buildings should undertake to improve health outcomes for government buildings. These strategies will be of special importance in public schools and any government-owned housing; however, these strategies are beneficial in all public buildings for improving community and worker health and leading by example.

First, as a baseline, all interior paints, coatings, adhesives, and sealants used in construction should meet the SCAQMD requirements for low/no VOCs, as specified in ASHRAE 189.1.[49]

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[47] International Living Future Institute (2018). "Offsite Renewables Exception." https://living-future.org/wp-content/uploads/2018/04/Net-Zero-Energy-Offsite-Renewables-Exception.pdf

[48] New Buildings Institute, 2019. "State and Local Government Toolkit." https://gettingtozeroforum.org/local-governments/ Accessed February 26, 2019

[49] South Coast Air Quality Management District. Rule 1113. Architectural Coatings. . http://www.aqmd.gov/home/rules-compliance/compliance/vocs/architectural-coatings Accessed February 13, 2019.

Second, the City can ensure that health-promotion is included in the planning process by requiring new public projects to pursue the LEED v4 *Integrated Process for Health Promotion* credit, worth 1 point.

This new credit aims to "support high-performance, cost-effective and health-promoting project outcomes through an early analysis of the interrelationships among building systems…[and] systematic consideration of the impact that project design and construction has on health and well-being (including physical, mental and social impacts)."[50] The LEED credit requires that the project team must include a public health partner—either an individual, or an organization or public agency that is focused on public health. A preliminary analysis before schematic design explores how to promote health for the communities that will occupy and be impacted by the project.

Notably, special consideration must be given for the disparate impact that construction could have on vulnerable community members. Once key strategies are identified to address existing health needs and minimize health risks, the project must implement those strategies as appropriate. Finally, the team and City would collaborate with the public health partner to develop a performance monitoring plan to ensure the strategies are implemented and that the health outcomes are being met.

If Alexandria wants to make a strong health statement in an important public building project, the City could also aim for a health and wellness certification such as WELL of FITWEL for the project. However, listing this as a core requirement in an RFP might increase costs beyond the City's ability to pay. Rather, this would be appropriate to list under the "if possible" goals in a performance-based procurement model (as discussed below).

Alexandria should continue to track developments in real-time post-occupancy Indoor Air Quality (IAQ) testing, and where feasible, could also consider implementing testing on a per-project basis. Projects that take this path could earn up to 7 points in LEED BD+C for "performance-based indoor air quality design and assessment."[51] Requirements for post-construction, pre-occupancy IAQ testing are also found in the International Green Construction Code (IgCC). Language from the DC Green Construction Code, which is modeled on IgCC is provided for reference—however, the latest IgCC should be consulted as standards are regularly updated. We recognize that while requiring post-construction IAQ testing and monitoring is a best practice, it may not be feasible for all public projects at this time.

[50] Integrative Process for Health Promotion | U.S. Green Building Council. (2019). Retrieved from https://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthc-106

[51] Performance-based indoor air quality design and assessment | U.S. Green Building Council. (2019). Retrieved from https://www.usgbc.org/node/11656219?return=/pilotcredits/New-Construction/v4

Table 11: IgCC Maximum Concentration of Air Pollutants

MAXIMUM CONCENTRATION OF AIR POLLUTANTS RELEVANT TO IAQ	MAXIMUM CONCENTRATION, µg/m3 (unless otherwise noted)
1-Methyl-2-pyrrolidinonea	160
1,1,1-Trichloroethane	1000
1,3-Butadiene	20
1,4-Dichlorobenzene	800
1,4-Dioxane	3000
2-Ethylhexanoic acida	25
2-Propanol	7000
4-Phenylcyclohexene (4-PCH)a	2.5
Acetaldehyde	140
Acrylonitrile	5
Benzene	60
t-Butyl methyl ether	8000
Caprolactama	100
Carbon disulfide	800
Carbon monoxide	9 ppm + no greater than 2 ppm above outdoor ambient levels
Carbon tetrachloride	40
Chlorobenzene	1000
Chloroform	300
Dichloromethane	400
Ethylbenzene	2000
Ethylene glycol	400
Formaldehyde	27
n-Hexane	7000
Naphthalene	9
Nonanala	13
Octanala	7.2
Particulates (PM 2.5)	35 (24-hr)
Particulates (PM 10)	150 (24-hr)
Phenol	200
Styrene	900
Tetrachloroethene	35
Toluene	300
Total volatile organic compounds (TVOC)	500
Trichloroethene	600
Xylene isomers	700

6.2.1.4 Performance-based procurement

To achieve net zero energy and other progressive performance targets, the City may wish to consider using a Performance-Based Procurement (PBP) methodology to achieve the highest level of feasible performance without increasing costs. The PBP methodology has been successfully implemented in

multiple government projects. A summary of the approach follows; for more, see the U.S. Department of Energy's "How-To Guide for Energy-Performance-Based Procurement."[52]

In a Performance-Based Procurement approach, the city issues an RFP stating the maximum budget and specific environmental performance goals for the project. Bidder's responses detail what level of environmental performance their team can achieve within the stated budget. While performance-based procurement allows a city to set minimum environmental performance targets for projects, there is also the opportunity to encourage incrementally higher performance by articulating tiers of performance in the RFP.

- Tier 1: "Mission Critical" outlines performance targets that are required in all basic responses to the RFP
- Tier 2: "Highly Desirable" outlines performance targets that represent a more ambitious level of performance overall
- Tier 3 "If Possible" outlines performance targets that are considered "best in class" and that could be pursued when project parameters and budget allow

The benefits of this approach include (a) the process guarantees a minimum standard environmental performance; (b) lowers the City's risk by bestowing the contractual responsibility for performance on the design team; (c) encourages innovation and creativity; (d) reduces design and construction costs; and (e) results in higher-performance buildings than a conventional procurement process.

One deficiency of this method is that it may be more challenging to adapt to community feedback, especially for the first such projects. Therefore, the approach may best be piloted in a new development area where there is community support for the required flexibility. We recommend that Alexandria use performance-based procurement on a pilot project basis, and, if successful, consider adopting this practice for more or all of its building procurement.

If the City decides it is not ready to require that a new project meet NZE standards, performance-based procurement is a good method to still incentivize project teams to strive towards NZE without adding to project costs and while providing a more modest alternative if no project teams find a cost-effective path to NZE.

6.2.1.5 Solar + Storage Feasibility

While the most recent storage study for Alexandria did not recommend energy storage beyond isolated backup use-cases, we recommend that the City periodically examine the feasibility, costs and benefits of installation of on-site solar and storage for all new projects, as costs continue to decline and regulatory environment for storage in the Commonwealth evolves. If the cost-benefit result is favorable, the project should go forward with investment in solar and storage. We recommend the use of available

[52] Pless, S., P. Torcellini, J. Scheib, B. Hendron, and M. Leach. 2012. "How-To Guide for Energy-Performance-Based Procurement." *U.S. Department of Energy.* https://www1.eere.energy.gov/buildings/publications/pdfs/rsf/performance_based_how_to_guide.pdf Accessed February 26, 2019.

tools such as SolarResilient to estimate the size of solar and associated storage needs, per the City of San Francisco's example.[53],[54]

6.2.2 Existing Public Buildings:

The EAP calls for a 20% reduction in energy use by FY2023 in the existing public building portfolio. This goal can be achieved through a combination of effective energy managements through conducting basic energy efficiency retrofits and better operations and maintenance across the whole portfolio, and initiating deep energy retrofits in select buildings planned for major renovations.

Benchmarking is the act of measuring the energy performance of a building and comparing it to both its own past performance and peer buildings. It is an essential first step for energy management. The City already benchmarks all facilities 5,000 sf and larger using the ENERGY STAR Portfolio Manager platform. Alexandria City Public Schools also benchmarks most of their buildings.[55] In our experience, benchmarking is highly valuable, but only if the data is then used for energy efficiency projects and regularly checked for quality. We recommend that a staff person or intern be assigned each year to review the data for quality assurance/quality control (QA/QC), and to review methods and improvements for data usage. For high energy use buildings, we recommend that the City go beyond benchmarking and undertake retro-commissioning to ensure the buildings operate as designed and at peak efficiency.

EPA's ENERGY STAR® Portfolio Manager® tool provides an energy use intensity (EUI) value for buildings and a 1-100 score for several key building types such as schools and offices. Though City government buildings 5,000 sf and larger are currently benchmarked, integration with the utility data management needs fixing. Benchmarking also benefits from regular QA/QC of the space use assumptions. Alexandria should also consider creating a public dashboard of public building energy usage data to increase transparency and help building owners in the private sector see the value of advanced metering.

We further recommend that the City develop a Strategic Energy Management (SEM) Plan for the entire portfolio. A SEM plan should establish the City's ongoing approach to persistently identify, assess, prioritize, and implement energy and GHG reduction measures.[56] As authorized in EAP Phase 1[57] and the FY19 Capital Improvement Plan, Alexandria is working with the Rocky Mountain Institute (RMI) to leverage their portfolio optimization approach to improve building performance and bring better data analytics to bear. The results of this effort will be aligned with the City's asset value approach to prioritize green investments, such as HVAC replacements. The DOE Asset Score may also be a useful tool to use as part of a SEM plan to identifying buildings most in need of attention.

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[53] City and County of San Francisco. Solar Resilient. https://solarresilient.org
[54] Solar and Energy Storage for Resiliency (Solar Resilient). (2019). City and County of San Francisco. https://sfenvironment.org/solar-energy-storage-for-resiliency
[55] Per City of Alexandria Energy Manager, February 11, 2018.
[56] Rogers, E., A. Whitlock, and K. Rohrer. 2019. "Features and Performance of Energy Management Programs. *American Council for an Energy Efficiency Economy.* https://aceee.org/sites/default/files/publications/researchreports/ie1901.pdf Accessed February 26, 2019.
[57] Alexandria EAP 2030 Phase 1, Energy Efficiency Action #1

There is also a lot to learn from SEM and Continuous Energy Improvement programs that originally focused on industrial customers, these programs are increasingly targeting commercial and institutional facilities. SEM drives energy savings through operations and maintenance (O&M) actions and increased capital project activity. ISO 50001 provides a standard for energy management under which organizations "develop a policy for more efficient use of energy, fix targets and objectives to meet the policy, use data to better understand and make decisions about energy use, measure the results, review how well the policy works, and continually improve energy management."[58] The U.S. Department of Energy (DOE) offers a "50001 Ready Program," which provides organizations a self-guided approach to establishing an energy management system that adheres to ISO 50001. Organizations complete 25 tasks in the 50001 Ready Navigator software tool, measure and document their performance, and self-attest to their completion of the tasks.[59]

The SEM plan should specify any guiding policies, clarify roles and responsibilities, codify the methods used to evaluate potential opportunities, and identify and begin to resolve any organizational barriers. It should align with the scale of action called for in the balance of this report, particularly in regard to strategies for deep energy retrofits. Further, it should act as a roadmap to drive City buildings towards net zero energy performance levels over time.

Following on benchmarking and portfolio planning, we recommend that the City of Alexandria begin a deep energy retrofit program for public facilities. Often, it is temping to simply address the easiest "low-hanging fruit" of efficiency upgrades. However, this can make deeper retrofits more difficult to finance over time. In the next few years, Alexandria should target buildings for whole-building retrofits that aim to reduce building energy use by an average of 30%. By 2024, once the City has experience in operating NZE new buildings, the City should begin to target NZE retrofits of existing buildings.

Simultaneously, the City should continue to retrofit outdoor lighting at City facilities and public lighting to LEDs in order to reduce costs, as identified in EAP Phase 1 Energy Efficiency Action #3.

Additionally, the green lease recommendations discussed below under Strategy D would be a good fit for any spaces where the City acts as either a tenant or a landlord.[60]

[58] International Standards Organization. "ISO 50001 – Energy Management." https://www.iso.org/iso-50001-energy-management.html Accessed February 26, 2019.
[59] U.S. Department of Energy. "50001 READY PROGRAM." https://www.energy.gov/eere/amo/50001-ready-program Accessed February 26, 2019.
[60] Feierman, Andrew (2015). "What's in a Green Lease?" *The Institute for Market Transformation.* https://www.imt.org/wp-content/uploads/2018/02/Green_Lease_Impact_Potential.pdf

6.3 Strategy C: New Private Development Not Subject to Site Plan Review

EAP Action 3.1.e: "Introduce voluntary green building practices…for small buildings not subject to site plan review."[61]

6.3.1 Home Rating and Labeling Programs

The Home Energy Rating System (HERS) Index is an example of a nationally-recognized home rating system. Certified HERS Raters conduct an energy rating on a home to measure its energy performance. There are also several recognized energy labels for homes, most notably the U.S. DOE Home Energy Score, which assigns a 1 to 10 rating for the home's energy performance and provides a label. More than 100,000 homes nationwide have received U.S. DOE Home Energy Scores. Among other benefits, a Home Energy Score report includes recommended improvements and estimated future score and monetary savings if those improvements are completed.[62]

The benefits of rating systems and labels are that homeowners understand how their house is performing relative to other homes, and the possibilities for improvement. Homeowners can be motivated by learning about potential energy cost savings and comfort improvements. Labels and ratings can also be disclosed at the time of sale of a building and, for the seller, a house with a high rating may derive more value than an inefficient house with a lower rating.

Studies show that Home Energy Rating and Disclosure programs are linked to increased property values and improved investment in energy efficiency. There is a strong correlation in home energy ratings and increased home values, with appreciation rates of 2-6%, and 12-37% of home buyers are influenced to improve the energy efficiency of the home by a score report.[63] Homes with good energy ratings also spend less time on the market.[64]

One of the big concerns of realtors is that a poor energy score will make a home harder to sell; however, studies show that home energy ratings are not a key decision point for people making home purchase decisions—a poor rating is more of a tool to help a new owner improve a home than a disincentive to buy the home in the first place.[65]

Home ratings have also been linked improved outcomes for GHG emissions, market transformation and job creation. The National Association of State Energy Officers has put together a useful guide on the subject for state and local governments.[66]

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[61] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25.
[62] Home Energy Score | Better Buildings Initiative. (2019). Retrieved from https://betterbuildingsinitiative.energy.gov/home-energy-score Accessed February 11, 2019
[63] Alex Hill, Jean-Philippe Boutin, Francois Boulanger, Richard Faesy, and John Dalton. Predicting Home Energy Rating and Disclosure Program Impacts for North American Jurisdictions. *ACEEE Summer Study on Energy Efficiency in Buildings,* 2016. https://aceee.org/files/proceedings/2016/data/papers/7_218.pdf. Accessed October 31, 2017.
[64] Elevate Energy. Chicago Homes that Disclose Energy Costs Spend Less Time on Real Estate Market. April 22, 2014. https://www.elevateenergy.org/chicago-energy-cost-disclosure-homes/. Accessed October 26, 2017
[65] Hill et. al.
[66] National Association of State Energy Officers. "Home Energy Rating and its Benefits." https://empress.naseo.org/energy-labeling

Given state limitations, we recommend that Alexandria pursue state enabling legislation to operate a home rating and labeling program. The City could also work with the regional MRIS to incorporate energy information into home listings even without state legislation. The District of Columbia has been successful in working with MRIS to add this information to real estate listings, and this effort could be leveraged for Alexandria.[67]

6.3.2 Education and Capacity Building

Education programs for industry, including developers, architects and engineers improve baseline knowledge and local industry capacity to deliver high performance buildings. The City should coordinate and promote industry training programs, access to technical assistance, and online resources to support developers in achieving higher levels of building performance.

As the City continues to require or encourage a higher standard of environmental performance in its own buildings, it is also important that the staff working in planning, development, permitting and operations remain up to date on the latest green building standards, performance requirements, and other green design strategies required by and encouraged by the City. The City should introduce internal trainings with each update to the Green Building Policy, and record the training so that it is available and accessible to staff to review and for new staff to watch as they are on-boarded. Moreover, the City may need to hire additional staff to implement the policies recommended in this report. To effectively enforce the design targets in section 6.1, the City would benefit from at least one additional FTE with expertise in MEP engineering, and specifically in the evaluation of energy models.

6.4 Strategy D: Existing Private Buildings

> *EAP Action 3.1.e: "Introduce mandatory and/or voluntary green building practices for existing buildings (including historic)."*[68]

Without efficiency improvements in existing buildings, it will be impossible for the community to meet its greenhouse gas reduction goals. However, Alexandria is more limited in taking action in this space than many peer cities. The Commonwealth of Virginia is a Dillon Rule state, which means that a municipal corporation can exercise only the powers explicitly granted to them, or necessarily or fairly implied by a power expressly granted, or indispensable for the functioning of the corporation. [69]

While the state legislature has not delegated authority to local governments to introduce mandatory requirements for existing buildings not undertaking the development site plan review process, there are many voluntary programs the City could operate to increase the sustainability of existing buildings. Brief descriptions of possible programs are provided below. Since many of these programs would require additional program development, it may not be possible to include these in new Green Building Policy

[67] Adomatis, A. 2015. "What is Green Worth? Unveiling High-Performance Home Premiums in Washington, D.C." *Institute for Market Transformation.* https://www.imt.org/resources/what-is-green-worth-unveiling-high-performance-home-premiums-in-washington/
[68] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25.
[69] National League of Cities. "Cities 101—Delegation for Power." https://www.nlc.org/resource/cities-101-delegation-of-power Accessed February 26, 2018.

update planned for June 2019. Rather, these ideas are provided to inform the mid-term actions for EAP Phase 2, or for integration into future Green Building Policy updates.

6.4.1 Promoting Benchmarking

The City could work to expand education to building owners regarding the benefits of tracking energy use and taking steps to improve performance. A good first step is getting buildings to benchmark their energy use in Portfolio Manager. As referenced above, Portfolio Manager provides a free, easy-to-use, online interface to track energy use, and generate a 1-100 ENERGY STAR score. The ENERGY STAR score tells a building owner how their building compares to other similar buildings, adjusting for location, building type, and building use characteristic (such as operating hours, number of workers, unit density), and is useful for both tracking performance over time and against one's peers. Buildings with scores of 75 or above are eligible for ENERGY STAR certification. EPA has found that buildings that consistently track their energy use save an average of 2.4% in energy usage.[70]

Many large buildings in Alexandria already use Portfolio Manager to track their energy use; as listed in Appendix A, there are 99 ENERGY STAR certified buildings in Alexandria, and the Washington, DC, metro region overall has more than 650 ENERGY STAR certified buildings.[71] However, many smaller building owners may not have yet discovered the benefits of benchmarking. The City could promote this practice by producing case studies on buildings that have used benchmarking to improve their energy efficiency and could use existing resources from EPA's ENERGY STAR program.[72] Such flyers or brochures would be most effective when combined with information of energy efficiency incentives offered in Virginia by Dominion, so building owners can maximize the financial benefits of energy retrofit projects.

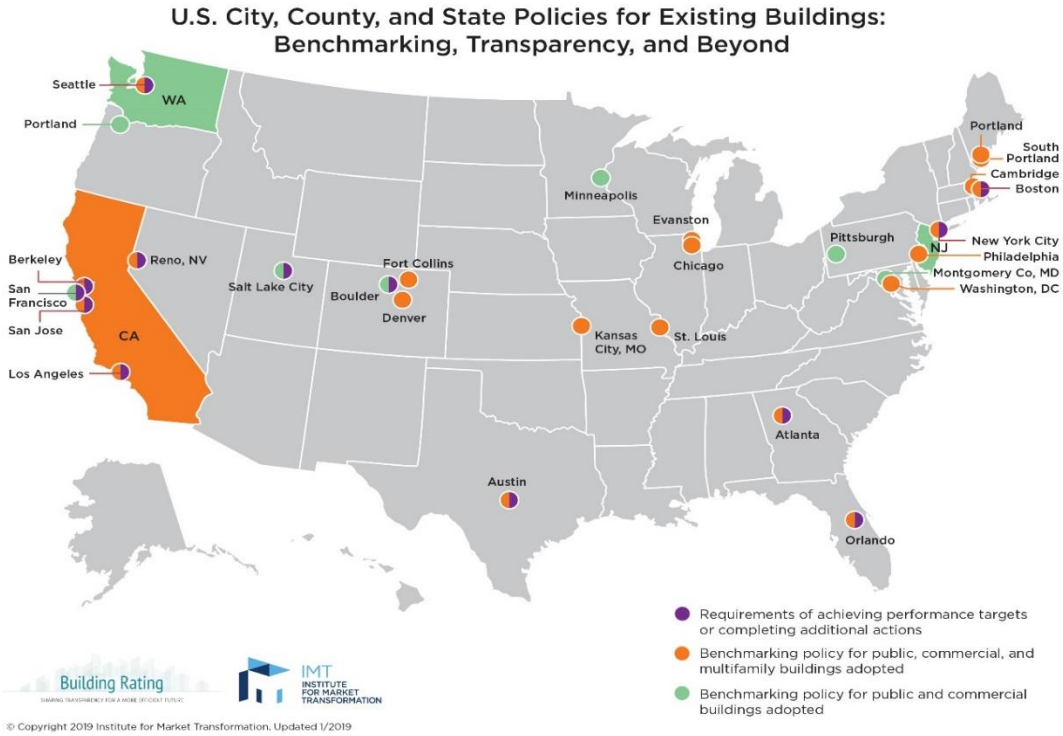
One of the major barriers to using Portfolio Manager for some buildings—especially multifamily—is that the building owner may not have access to tenant utility data. Requesting data from each tenant is cumbersome and often unsuccessful. However, many utility companies around the country provide a service where they aggregate data at the whole building level, and then provide that information to building owners using direct automated upload of the data to Portfolio Manager.[73] Washington Gas provides this service to building owners in Alexandria, but Dominion does not yet.[74] Alexandria could work with Dominion to encourage them to offer this service for their customers as well; this would be particularly important if the Commonwealth were ever to allow mandatory benchmarking programs. This issue has already been discussed at the state level through a workgroup led by the Virginia Department of Mines, Minerals, and Energy (DMME) in 2017 "to work through key concerns regarding utility data access and to assist in drafting legislation that would allow localities to implement

[70] For the full EPA DataTrends series, including savings specific to different building types, see: https://www.energystar.gov/buildings/tools-and-resources/datatrends-benchmarking-and-energy-savings
[71] EPA ENERGY STAR (2018). "Top Cities 2018" https://www.energystar.gov/buildings/topcities Accessed February 12, 2019.
[72] For example: https://doee.dc.gov/service/energy-benchmarking-case-studies
[73] Map of utilities providing data access: https://www.energystar.gov/buildings/owners_and_managers/existing_buildings/use_portfolio_manager/find_utilities_provide_data_benchmarking
[74] Washington Gas, "Energy Benchmarking" https://www.washingtongas.com/business-owners/services/energy-benchmarking. Accessed February 12, 2019.

mandatory commercial benchmarking programs."[75] The Institute for Market Transformation and the Data Access and Transparency Alliance provide a wealth of resources to support this effort.[76]

As more than 25 cities nationwide have found, there is real benefit to having a mandatory program for benchmarking and public transparency of energy usage. Alexandria has joined Richmond, Arlington, and other local governments in advocating for state enabling legislation to allow local benchmarking and energy disclosure programs for commercial, multifamily, and single-family buildings. Indeed, the DMME final report in 2017 recommended that the Commonwealth "enable localities to implement mandatory benchmarking programs for large commercial and industrial users and encourage utilities to adopt national best practices for enabling customer and third-party data access;" this recommendation is repeated in the 2018 Virginia Energy Plan. [77, 78]

Figure 3: Benchmarking Ordinances in the United States



[75] Commonwealth of Virginia. "Virginia Energy Efficiency Roadmap" https://www.dmme.virginia.gov/de/LinkDocuments/VAEERM%20FinalRoadmap_20180327.pdf Published December 31, 2017. Accessed February 26, 2019.
[76] Institute for Market Transformation, "Data Access and Transparency Alliance." https://www.imt.org/how-we-drive-demand/bringing-the-right-stakeholders-to-the-table/utilities/data-access-and-transparency-alliance/ Accessed February 12, 2019.
[77] Virginia Energy Efficiency Roadmap
[78] Commonwealth of Virginia. 2018. "Virginia Energy Plan." https://www.governor.virginia.gov/media/governorvirginiagov/secretary-of-commerce-and-trade/2018-Virginia-Energy-Plan.pdf

6.4.2 Challenge Programs

Many jurisdictions have had success in promoting energy efficiency through voluntary challenge programs. An example was the City of Arlington's "Green Games" voluntary program, which promoted energy efficiency and greenhouse gas reductions among office buildings through a voluntary label that offices could post publicly.

The challenge can also be between communities--the U.S. Department of Energy's Better Buildings Challenge allows communities to join as partners, and the local government, usually in conjunction with a non-profit partner, works to get local businesses and buildings to join the challenge, share benchmarking data, and commit to reducing their energy use by 20% over 10 years.[79] At the community level, the most successful Better Buildings Challenge programs have been in Atlanta and Los Angeles; their experience shows that challenge programs are most effective when they include networking events, best practice resources, and non-financial motivators like awards.

6.4.3 Educational Programs

Many building owners and managers don't know how to make their property greener. Educational resources from the local government can helpfully address this gap. One notable local example is the Sustainability Guide for Historic Properties that was produced for the District of Columbia government.[80]

For single family homes, access to resources and information is a barrier to homeowners making improvements to their houses. Alexandria should develop or promote existing resources such as Vancouver's Green Home Renovation Guides.[81] Alexandria could incorporate elements from these resources and create guidelines for single family homes and larger historic properties.

6.4.4 Commercial Tenant Fit-Out and Green Leases

Lighting, controls, certain HVAC systems, and tenant-owned equipment (e.g., office/IT equipment, commercial kitchens) are routinely replaced at tenant turnover, and less frequently replaced at lease renewal. Many commercial tenant spaces, including office and retail, turn over on an average of once every seven years. This makes tenant turnover a key opportunity to improve efficiency and green building practices.

The current green building development condition from the City of Alexandria includes a requirement that developers "Provide documentation to future retail tenants encouraging them to operate their business consistently with the goals of LEED, as well as to pursue LEED for Retail or LEED for Commercial Interiors certification."[82] However, there is more that can be done to incentive green fit-outs. Alexandria can encourage and incentivize the use of energy efficient equipment and practices during tenant build out, such as sub-metering of tenant spaces, use of energy-efficient lighting and HVAC equipment,

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[79] Better Building Challenge, https://betterbuildingsinitiative.energy.gov/challenge
[80] District of Columbia Office of Planning - Historic Preservation Office. (2019). Sustainability Guide for Existing and Historic Properties. Washington, DC: District of Columbia Office of Planning. Retrieved from https://planning.dc.gov/publication/sustainability-guide-existing-and-historic-properties
[81] City of Vancouver. (2010). Green Home Renovation: Healthy Homes for a Healthy Environment. Vancouver. Retrieved from https://vancouver.ca/files/cov/green-home-renovations.pdf
[82] Information provided by the City of Alexandria, February 22, 2019.

occupancy sensors, and behavior programs. The City could also directly promote the use of green building certifications for interior spaces, including LEED for Interior Design and Construction (LEED ID+C) and Green Globes for Sustainable Interiors (Green Globes SI), in addition to asking developers to provide this education. The EPA ENERGY STAR program will also be developing and launching a new rating system for tenant spaces by 2020. Alexandria could work to drive early tenant adoption of this new system and use it to create a cornerstone for tenant awareness and action to improve efficiency.

Since many minor tenant build-outs do not involve complex lighting and HVAC work, but almost all involve new painting and new carpeting, opportunities to improve health outcomes can be realized during minor tenant alterations. As part of any program to promote green tenant build-outs, Alexandria could include information on materials that emit low or zero volatile organic compounds (VOCs). As discussed in sections 6.1.4 and 6.2.1, SCAQMD maintains a list of such chemicals.[83]

Green, or energy-aligned, leasing is a mechanism for aligning tenants and owners to support energy efficiency projects. Green leasing distributes the benefits of energy retrofit projects between the landlord and tenant. These leases overcome the split incentive problem, whereby landlords and tenants are disincentivized to undertake energy efficiency upgrades in buildings, as neither realizes the full benefit of the upgrades.

In a recent study, the Institute for Market Transformation (IMT) estimated that green leases could reduce energy consumption in U.S. office buildings by between 11% and 22%, thus reducing nationwide utility expenditures in commercial buildings by as much as $0.51 per square foot. The potential savings for the U.S. market for leased offices ranges from $1.7 billion to $3.3 billion in annual cost savings.[84]

Alexandria could provide education and resources for stakeholders such as brokers, lawyers, and commercial real estate companies, as well as building owners and tenants, to increase uptake of green leases. This can be done via round-table discussions, or by providing training. New York City has operated a good example of this sort of market assistance by promoting an "energy aligned clause" for commercial leases. The clause was developed in cooperation with the private sector and standardizes language and expectations to allow equitable sharing of investment costs and energy savings.[85] Alexandria should consider promoting similar language, and also recognize leaders in the industry who participate in green leasing.

The Green Lease Leaders program run by IMT and the U.S. DOE recognizes these organizations, and this effort could be promoted to owners and tenants in Alexandria. The Green Lease Leaders website also includes resources for tenants and landlords, and benefits and best practice examples of green leases.[86]

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[83] Super Compliant Coatings Manufacturers. (2019). South Coast Air Quality Monitoring District. "http://www.aqmd.gov/home/rules-compliance/compliance/vocs/architectural-coatings/super-compliant-coatings Accessed February 13, 2019.

[84] Feierman, Andrew (2015). "What's in a Green Lease?" *The Institute for Market Transformation.* https://www.imt.org/wp-content/uploads/2018/02/Green_Lease_Impact_Potential.pdf

[85] Mayor's Office of Sustainability. (2012). The Energy Aligned Clause: An overview of leasing language that solves the Split Incentive Problem in typical modified gross commercial leases for base buildings. New York City. Retrieved from http://www.nyc.gov/html/gbee/downloads/pdf/eac_overview.pdf

[86] Green Lease Leaders: Creating Sustainable Landlord-Tenant Relationships. (2019). Retrieved from https://www.greenleaseleaders.com/green-leasing-resources/

The U.S. General Services Administration's Green Building Advisory Committee also produced a useful guide to green leases based on over a year of analysis of green leasing concepts in the marketplace.[87]

6.4.5 Coordination with Utility Efficiency Programs

As authorized by recent Commonwealth legislation (SB796), Dominion Energy is developing substantial new energy efficiency programs, to be introduced in the next 10 years. Dominion has identified the City of Alexandria as a named stakeholder. City staff attended the kickoff on January 3, 2019 and are working with Dominion to identify meaningful programs that will benefit the Alexandria community and the Commonwealth as a whole.

6.4.6 Property-Assessed Clean Energy (PACE)

The City of Alexandria is exploring creation of a Commercial Property Assessed Clean Energy (C-PACE) program. C-PACE is an innovative way to finance clean energy projects on commercial, multifamily, and non-profit buildings. PACE loans can be long-term (up to 20+ years) and have high security similar in status to a property tax assessment. By setting up a C-PACE program, Alexandria could enable private sector loans for 100% of total project costs by placing a special assessment on the property that the owner repays over time as part of their tax bill. The loan payments can be equivalent to or less than the energy savings on the project, and thus be cash flow positive from day one. In 2009, Virginia joined more than 30 states and the District of Columbia in adopting C-PACE legislation (with amendments in 2015). Rather than operating a state-level C-PACE program, the Virginia law authorizes local governments to operate C-PACE.

The EAP Phase 1 calls for the adoption of an ordinance to implement C-PACE in Alexandria by July 2020. To ensure that C-PACE is successful, we recommend that the City dedicate staff resources of at least 1 FTE, either directly hired or contracted, to not only craft strong legislation, but also form partnerships with private sector lenders, provide education to the community, and oversee the program. C-PACE is often attractive to entities such as small businesses, non-profits and public service institutions, affordable housing and houses of worship, that have trouble getting sufficient low-cost credit in the private market, or who need more off-balance-sheet credit. However, these sectors also often require additional outreach and engagement; without strong staff support and public education, a C-PACE program in Alexandria may struggle to gain market share.

6.4.7 Legislative Agenda

As mentioned above, the Dillon Rule in the Commonwealth restricts the regulatory powers of local governments to those explicitly authorized by the state. Therefore, it is especially important that the City advocate for legislation at the state level that will provide additional authority or address existing issues in Commonwealth policies. Building on the items discussed above, and the legislative agenda items listed in the EAP Phase I report, we recommend that the City advocate for legislation to:

[87] GSA GBAC (2016). "High Performance lease criteria and sample lease language." https://www.gsa.gov/cdnstatic/GBAC_HP_Leasing_Criteria_-_FINAL.pdf December 6, 2018. Accessed February 13, 2019.

- Provide local jurisdictions with authority to require large private buildings to annually measure and disclose their energy performance to the jurisdictions and authorizing the cities to make this data public. Enabling legislation should also authorize the local jurisdictions to create policies related to the benchmarking data, such as requiring energy audits or retro-commissioning for poor performing buildings.
- Enable local jurisdictions to require energy performance disclosure by home sellers to home buyers at the point of sale.
- Municipal Net Metering: Allow municipalities to install and interconnect solar systems on buildings that exceed the building's annual electricity demand and aim to also serve other buildings in a portfolio.[88]
- Make it easier for large energy users to purchase renewable energy directly from third parties via power purchase agreements.
- Establish design, construction, and maintenance standards for public school buildings, including entering into third-party energy savings performance contracts, expand net metering of renewable energy at school buildings, and increase funding for school retrofits.[89]
- Continue to adopt the most recent IECC code, without weakening amendments.

6.5 Strategy E: Incentives for All New and Existing Privately-Owned Buildings

EAP Action 3.1.c: "Establish incentives for private development participation in green building certifications."[90]

As discussion in Section 3, Alexandria has had a strong rate of compliance and good uptake for its Green Building Policy without any financial incentives. However, structural and/or financial incentives may be beneficial in encouraging developers to strive for higher standards of performance than required by the base policy, such as LEED Platinum, Net Zero Energy, Passive House, Living Building Challenge, or significant stormwater retention. Incentives could also be useful in increasing the uptake of Green Building in smaller buildings that are not subject to plan review.

6.5.1 Floor Area Exclusions to Accommodate Passive Design Elements

This is a mechanism that allows additional floor area, height, form and/or setback relaxations for buildings that include passive design elements that have an impact on FAR or the building massing. Any additional square footage demonstrated to be a result of a passive design element is excluded from the total floor area calculation. This could include continuous exterior insulation above and beyond code requirement, which increases the thickness of exterior walls, exterior shading devices, or double-skin walls that add extra thickness. Height relaxations, setbacks and other zoning adjustments could be allowed to accommodate building features designed to reduce energy consumption.

[88] H.B. 2792, which was passed by the legislature, would accomplish this for municipal portfolios.
[89] H.B. 2192 and S.B. 1331
[90] City of Alexandria Environmental Action Plan (EAP) 2030, Phase One Update. October 13, 2018. Page 25.

For an example of this type of policy, see Vancouver, BC passive design exclusions and guidelines to accommodate projects pursuing Passive House certification.[91]

6.5.2 Density (FAR) and/or Height Bonus

While FAR bonuses are widely used in other jurisdictions, we recommend that the City use this mechanism to support higher levels of green building only in the commercial building sector. In the residential sector, the City's existing bonus density and height provision supports affordable housing as an effective mechanism for encouraging new development of affordable units. In much of the city, the introduction of an additional bonus coinciding with this existing program is not advisable because the scale of much of the development in Alexandria is moderate and thus maximum densities are relatively limited; and (b) for the residential sector, the City should avoid circumstances in which a developer would need to select between either construction of affordable housing or high-performance environmental design. This would be at odds with the City's desire to promote both affordability.

However, there are some areas of the city, such as Potomac Yards and Eisenhower East, where potential for additional density above current limits exists. In these areas, a FAR and/or height bonus for higher levels of green building construction could work as long as it is stacked on top of affordability bonuses rather than replaces them. Establishing such areas as a "Green Zone" could allow the successful application of the incentives to promote deeper green building without impacting affordability. Green Zones could also be used to require district energy analysis for large development projects, as done in Loudoun County. The Commonwealth has enabled local jurisdictions to create Green Zones. A full examination of Green Zones is outside the scope of this report but is being analyzed by City staff.

6.5.3 Expedited Permitting

Expedited or accelerated review of building permitting (or first-in-line permitting efforts) is used in many jurisdictions to reward projects with high environmental design with faster turnaround times for construction permitting, which in turn shortens overall project timelines, thus saving developers money. This has been effective in other cities (see best practices Appendix A), where the standard building permit process can take a period of months. While the entire entitlement and site plan review process in Alexandria may take several months, the building permit review process in Alexandria is 15-20 business days for each submission. Therefore, expedited building permitting is not included in our recommendations to the City of Alexandria as the current building permit processing time in the City cannot be further accelerated without sacrificing rigor.

6.5.4 Tax Incentives

Tax incentives can be structured in a variety of ways depending on the desired scale of financial incentive, target audience, and other applicable factors. For smaller developments not subject to site plan review where structural incentives are less applicable, the City could consider adoption of financial

[91] City of Vancouver - Planning, Urban Design and Sustainability Department. Floor Space Exclusion to Accommodate Improved Building Performance (Envelope and Thermal Insulation) (2018). Vancouver. Retrieved from https://bylaws.vancouver.ca/bulletin/F008.pdf

incentives, such as tax credits. Offering tax credits for energy-efficient buildings is authorized under Virginia code § 58.1-3221.2.

Per WSP's analysis, "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."

APPENDIX A: Best Practice Survey

Alexandria and Peer Cities Comparative Analysis

This section details best practices in Green Building policy from selected municipal and county governments from across the country. Table 12 lists cities that are national leaders in green building policy and are of similar size and/or density as Alexandria, along with the green building accomplishments in each city; it is sorted by LEED-certified square footage per capita. Further discussion on these policies, and other leading policy examples from North America, follows.[92] A checkmark in the column labeled "Dillon Rule?" indicates that the city falls under Dillon Rule as opposed to Home Rule. The Dillon Rule cities have similar powers and limitations as Alexandria.

Table 12: Peer City's Green Building Achievements, Including LEED Certified Floor Area Per Capita

City	Population	Area [sq. mi.]	Density ppl/sq. mi.]	LEED Activities	LEED M sq. ft.	LEED per capita [sf/per]	ENERGY STAR Buildings	ES M sq. ft.	ES per capita [sf/per]	Dillon Rule?	Green Building Policy (bolded policies are discussed further below)
Washington, DC	693,972	68.3	10,155	1,009	181.10	261.0	452	140.30	202.2		**International Green Construction Code, optional NZE code, LEED Silver for private new construction and major renovations over 50,000 ft2, LEED Gold for public building new construction, Stormwater Retention of 1.2", goal of mandatory NZE by 2026**
Arlington, VA	234,965	26.0	9,037	212	48.42	206.1	124	37.29	158.7	✓	**Density Bonus for LEED Silver (0.25 FAR) through LEED Platinum (0.5 FAR), with additional bonus for local priority credits**
Cambridge, MA	113,630	7.1	15,937	198	18.35	161.5	49	7.71	67.9		LEED Silver (buildings over 50,000 sf), NZE goal by 2040
Boston, MA	685,094	89.6	7,644	377	100.10	146.1	187	70.79	103.3		**LEED Certified plus local priority credits**

[92] LEED and ENERGY STAR information sourced from: USGBC Green Building Information Gateway (GBIG), http://www.gbig.org/ Numbers current as of February 1, 2018. Policy Information sourced from USGBC Public Policy Library, https://public-policies.usgbc.org/, with supplementary verification on city websites.

City	Population	Area [sq. mi.]	Density ppl/sq. mi.]	LEED Activities	LEED M sq. ft.	LEED per capita [sf/per]	ENERGY STAR Buildings	ES M sq. ft.	ES per capita [sf/per]	Dillon Rule?	Green Building Policy (bolded policies are discussed further below)
Seattle, WA	724,745	83.8	8,651	400	88.78	122.5	234	65.40	90.2		**Aggressive EUI targets (<35 kBtu/ft2), LEED Gold required for zoning amendments, Living Building Challenge incentive program.**
Sunnyvale, CA	153,656	22.7	6,772	99	18.43	119.9	50	5.47	35.6		**Density bonus for LEED Gold Certification. LEED credits can be used to comply with aspects of the CALGreen Green Building Code.**
Alexandria, VA	160,035	15.5	10,325	89	12.86	80.4	99	15.67	97.9	✓	LEED Silver for Commercial LEED Certified for Multifamily
Santa Monica, CA	92,306	8.4	10,963	63	6.75	73.1	46	6.20	67.1		**NZE requirement for single-family and low-rise multifamily new construction. Density bonus for non-residential projects that meet LEED Platinum along with other local requirements.**
Burlington, VT	42417	15.5	2,737	42	2.09	49.3	7	0.57	13.4	✓	Height and density bonus may be permitted for construction or renovations that achieve LEED Silver certification; additional density bonus available to buildings in the downtown with LEED Gold or Platinum.
St. Paul, MN	306,621	56.2	5,458	37	6.79	22.1	55	13.15	42.9		**LEED Silver or better, along with local priority credits**
Berkeley, CA	122,324	17.7	6,915	44	2.41	19.7	21	1.29	10.6		LEED Gold for buildings in downtown area LEED Certified elsewhere
Newark, DE	33398	31.19	1,071	3	0.31	9.3	9	0.65	19.5	✓	LEED certification required for site plan approval in high density areas
Nashua, NH	88341	31.9	2,769	6	0.22	2.5	10	1.41	16.0	✓	Permit fee discounts of 5%-20% for LEED certification, depending on the level of certification.

Best practices by strategy type

Below is a selection of best practices from other jurisdictions, organized by strategy type.

Strategy A: Increase LEED or equivalent third-party green building certification standards for private development and prioritize specific green building elements in private development projects.

Path 1: LEED plus prescriptive credits

Arlington County, Virginia

Type: FAR (Floor Area Ratio) Bonus available to private buildings

Arlington County's Green Building Density Incentive Program allows a density bonus for residential and commercial buildings that achieve **LEED** under the appropriate rating system.

Table 13: Arlington, Virginia Green Building Density Bonus

LEED version 4	Office or Residential	Two Arlington Priority Credits	Total Bonus FAR Available
Silver	0.25 FAR	+ 0.05 FAR	0.30
Gold	0.35 FAR	+ 0.05 FAR	0.40
Platinum	0.50 FAR	+ 0.05 FAR	0.55

An additional 0.025 FAR is available for projects achieving **one of eight Arlington priority credits**. Credit will be given for up to two credits. These priority credits include:

1. Optimize Energy Performance 9% – at least 9% improvement over the LEED prerequisite
2. Optimize Energy Performance 12% – at least 12% improvement over the LEED prerequisite
3. Enhanced Envelope Commissioning
4. Renewable Energy Production (1%+ of energy use annually from onsite RE)
5. Site Development – Protect or Restore Habitat
6. Bird Collision Deterrence Pilot Credit
7. Building Life-Cycle Impact Reduction (building materials reuse and salvage)

Path 2: LEED plus independent requirements

Chicago, Illinois

Type: Requirement for new development; combination of specific requirements not tied to LEED credits, but some points available from LEED or other rating systems.

Chicago Sustainable Development Policy: The new policy allows development teams to choose from a menu of strategies that can be tailored to fit the project's characteristics. Each strategy is assigned a

point value. New construction projects are required to achieve 100 points. Compliance form can be found here.

The updated policy provides two compliance paths. The first path does not require building certification. Projects choosing this path must meet the 100 points required through the strategies listed in the menu.

The second path is for project teams choosing to achieve building certification. Points are automatically given to these projects depending on the type of building certification being achieved, as well as the level of certification in some instances. Additional points are also required, except for projects that are being certified under the Living Building Challenge program.

Saint Paul, Minnesota

Type: Requirement for private buildings receiving >$200k funding; similar requirements for municipal buildings.

The City of St. Paul implements a Sustainable Building Policy for Private Development. Any project, commercial or residential, receiving more than $200,000 in City or HRA funding (e.g. CDBG funding, Low Income Housing Tax Credits) is required to achieve LEED Silver or better, as well as specific measurable standards called the Saint Paul Overlay. These standards include further City-specific requirements for water use, stormwater management, indoor environmental quality, and energy through the Minnesota Sustainable Building 2030 Standard.

Boston, Massachusetts

Under Article 37 incorporated into the Boston Zoning Code, any project that requires a building or use permit (required for new construction greater than 100,000 sq. ft.) must achieve, at minimum, LEED Certification under the appropriate LEED rating system.

The City advances city-specific goals by allowing up to four of the required LEED points to be obtained from the Boston Green Building Credits. This city-specific program offers sustainability points in four categories:

1. Modern Grid
2. Historic Preservation
3. Groundwater Recharge
4. Modern Mobility

Washington, DC

DC requires LEED-Silver certification for all new private construction or major renovations 50,000 sq. ft. and larger, and LEED-Gold certification for all new public construction or major renovations 10,000 sq. ft. and larger. The City has also adopted the International Green Construction Code (IgCC), for every other project 10,000 sq. ft. and larger in the city.

The District also requires a stormwater retention for the first 1.2 inches of storm events for new construction and 0.8 inches of retention for renovation projects, in accordance with the DC 2013 Stormwater Management Rule and Guidebook.

Path 3: No LEED Link

Vancouver, British Columbia, Canada

City of Vancouver Rezoning Policy:

In Vancouver, building project have to achieve either:

- The Near Zero Emissions Building Standard and Energy System Sub-Metering and Reporting; or
- LEED Gold - Building Design and Construction with performance targets (EUI or GHG intensity), airtightness testing, enhanced commissioning, submetering and reporting, refrigerant and embodied emissions targets, and integrated rainwater management and green infrastructure.

Toronto, Ontario, Canada

The Toronto Zero Energy Building Framework establishes Total Energy Use Intensity (TEUI), Thermal Energy Demand Intensity (TEDI), and Greenhouse Gas Intensity (GHGI) targets for all new buildings, with multiple tiers. Toronto also has a stormwater retention requirement of 10-25mm depending on the building project.

Seattle, Washington

Seattle code establishes Energy Use Intensity (EUI) targets for all new commercial and multifamily buildings.

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.

Seattle, Washington

Seattle's Sustainable Buildings and Sites Policy for municipal buildings sets the following goals for City-owned properties:

- New construction and major renovations 5,000 square feet or greater must meet LEED Gold, as well as key performance requirements for energy and water efficiency, waste diversion and bicycle facilities:
    - Achieve an EUI that is a minimum of 15% more efficient than a baseline building meeting the 2009 Seattle Energy Code.
    - Achieve a projected water use performance that is a minimum of 30% more efficient than the 2009 UPC.
    - Achieve a waste diversion of 90% for construction and demolition.
- Tenant improvements 5,000 square feet or greater, with a scope of work that includes mechanical, electrical and plumbing, must meet LEED Gold, as well as water efficiency and waste diversion requirements.
- Small projects, either new construction, renovations or tenant improvements, are required to utilize Capital GREEN, a local green design and construction evaluation tool, in project planning and development.
- All new and existing site projects shall follow best management practices.

St Paul, Minnesota

The Sustainable Building Policy for New Municipal and HRA Owned Buildings in the City Of Saint Paul applies to any planning, design, construction, and commissioning of municipal or HRA owned facilities financed by the City of Saint Paul or HRA and those buildings utilized by the City's Executive Departments, the Saint Paul Public Library, or the Saint Paul Parks and Recreation Department.

The policy includes the following options for commercial projects:

- LEED New Construction - Silver
- Green Globes - 2 globes
- State Guidelines Building, Benchmarking and Beyond (B3) compliance
- Saint Paul Port Authority Green Design Review (as applicable)

The policy includes the following options for residential projects:

- LEED for Homes or LEED New Construction - Silver
- Minnesota GreenStar - Silver

The following mandatory requirements, established in the 2009 Sustainable Building Policy as the "Saint Paul Overlay," must be met within the chosen rating system:

1. Predicted energy use shall meet Minnesota Sustainable Building 2030 (SB 2030) "Energy Standards" for new buildings. The conditions for meeting the Energy Standards are subject to the Cost Effectiveness Protocol of SB 2030.
2. Predicted use of potable water in the building must be at least 30% below EPA Policy Act of 1990.
3. Predicted water use for landscaping must be at least 50% less than a traditionally irrigated site using typical water consumption standards for underground irrigation systems.
4. Construction materials, excluding demolition waste, must be at least 75% recycled or otherwise diverted from landfills.
5. Indoor Environmental Quality (IEQ) must be addressed through the following strategies:
    a. Ventilation based on ASHRAE 62.1-2004 or meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007
    b. Creation of a construction IEQ management plan
    c. Use of low-emitting materials
    d. Creation of thermal comfort
6. Storm Water Management Requirements:
    a. *Site Eligibility:* Sites with ¼ acre or more of total land disturbance
    b. *Rate Control:* 1.64 cubic feet per second (cfs) /acres disturbed
    c. *Water Quality Management:* For a 2-year, 24-hour rainfall event, projects must provide treatment systems designed to remove 80% of the average annual post development Total Suspended Solids (TSS) and remove 60% of the average annual post development Total Phosphorus (TP) by implementing Best Management Practices (BMPs) outlined in "Urban Small Sites Best Management Practices" handbook (Metropolitan Council), "Protecting Water Quality in Urban Areas"

handbook (Minnesota Pollution Control Agency), or the "Minnesota Storm Water Manual" (Minnesota Pollution Control Agency). All BMP treatment systems for the site must include safety factors, maintenance, and a back-up plan in case of failure. All manufactured devices require independent laboratory testing to confirm product claims.

d. *Volume Control/Infiltration:* Must maintain or increase infiltration rates from pre-project site conditions.
e. *Operations and Maintenance:* All practices must have an operations and maintenance plan.

7. Predicted greenhouse gas emissions must be reported to the Minnesota Sustainable Building 2030 database by the design team or building owner.
8. Annually, actual energy data for the project must be submitted to the Minnesota Sustainable Building 2030 database by the building owner or by the building's utility service provider(s) with permission of the owner.

Maryland

The State of Maryland's High Performance Green Building Program requires all new State buildings, including schools funded entirely with state funds, 7,500 sq. ft. or greater to achieve a minimum of LEED Silver or two Green Globes. In addition, the following LEED credits are mandatory:

1. Light Pollution Reduction
2. Water Efficient Landscape – 50% minimum reduction
3. Indoor Water Use Reduction – 35% minimum reduction over the minimum code
4. Optimize Energy Performance – 15% better than IECC
5. Construction Waste Management – 75% minimum reduction
6. Low Emitting Materials – 1 point minimum
7. IAQ During Construction
8. IAQ Before Occupancy (v3 only)

Mississauga, Ontario, Canada

Green Building Standard (under development)

Mississauga is considering use of performance-based procurement to encourage net zero energy and highly-energy efficient new public buildings.

STRATEGY C: Introduce voluntary green building practices for small buildings not subject to site plan review.

Arlington, Virginia

Arlington's Green Home Choice Program is a free green home certification program.

Austin, Texas

The City has created the Austin Energy Green Building Single-Family Rating System.

Surrey, British Columbia, Canada

Surrey is following the British Columbia (BC) Energy Step Code. Three key aspects of the BC Step Code that distinguish it from current BC Building Code energy requirements:

4. Performance-based: Offering builders design flexibility, as opposed to a lengthy suite of prescriptive technical requirements for individual building components.
5. Envelope-focused: Recognizing the need to help ensure that the building envelope (e.g. walls, foundation, ventilation), which is unlikely to change or be upgraded over the building's life, is designed and constructed efficiently from the beginning.
6. Explicit airtightness targets: The lowest cost way to improve building performance.

STRATEGY D: Introduce voluntary green building practices for existing buildings (including historic). Also, advocate for legislative authority to add mandatory green building standards.

Arlington, Virginia

- Green Games – voluntary energy disclosure and competition (discussed earlier).

Better Building Challenge (National)

- National U.S. DOE energy competition, but multiple cities have run local challenges based on it; best practice examples include Atlanta, GA, Los Angeles, CA, and Chicago, IL

2030 Districts (Various Cities in North America)

- Private sector led, government-supported programs in central business districts or other commercial neighborhoods to encourage tracking and disclosure of energy use, technical assistance, knowledge sharing, and group purchasing
- 20 in U.S. and Canada

Educational Programs

- DC: Sustainability Guide for Historic Properties
- NYC: Building Energy Exchange (BE-Ex) provides technical assistance, training, and networking, and best practice showcases
- NYC: Retrofit accelerator; emissions performance standards
- VA: Weatherization Assistance Programs (for single family and multifamily); administered in Alexandria by Community Housing Partners

Mandatory Programs

- Commercial benchmarking in 25 jurisdictions
- Beyond benchmarking programs for audit, retro-commissioning, improvement mandates in 11 jurisdictions
- Single-family home energy disclosure in 2 jurisdictions—Berkeley, CA, and Austin, TX
- Public posting of energy performance in building lobbies required in at least 3 jurisdictions—New York City, NY, Chicago, IL, and Austin, TX
- Minimum energy performance standards recently passed in DC and in consideration in NYC

STRATEGY E: Establish incentives for private development to incorporate green building elements.

Many cities have adopted green building incentive programs. Incentives are based on strategies such as higher levels of LEED certifications, installation of onsite renewable energy, and/or achievement of greater energy efficiency. Incentives typically fall in to the following types:

- FAR or height bonus
- Expedited permitting
- Tax credits

Surrey, British Columbia, Canada

Surrey has an incentive program tied to the BC Energy Step Code.

Arlington, Virginia

Arlington has a PACE financing program (first C-PACE program in the state of Virginia).

San Jose, California

San Jose's Affordable Housing Investment Plan offers priority consideration for financing to housing developers who put green building features into supportive and affordable housing units.

Austin, Texas

Austin's Downtown Density Bonus Program allows for 25% increased FAR if a project achieves Austin Energy 3-Star rating or LEED Silver.

Sunnyvale, California

Sunnyvale has a multi-family incentive program for projects that achieve 110 points with a Green Point Rater which equals a 5% increase in lot coverage, an increase building height by 5', or receipt of a 5% density bonus. The City also has a commercial incentive program allowing an increase in FAR by 10% or height by 10 feet for project teams achieving LEED Gold certification.

Mountain View, California

Mountain View has a FAR bonus for non-residential projects that are covered under the North Bayshore Precise Plan and meet LEED Platinum, exceed California's Title 24 by 10%, incorporate on-site renewable energy for 5% of building use (or achieve an additional 10% reduction in energy use), reduce potable water use by 40% indoors and 85% outdoors, divert 80% of construction waste, and plan to divert 90% of post-construction materials from landfill.

Boston, Massachusetts

Development review guidelines for commercial buildings in the Stuart Street area of Boston have a standard maximum height of 155 feet, but if a project is certified as LEED Gold, it is eligible for a height bonus up to a maximum height of 400 feet.

Boston's E+ Green Building Program provides a development opportunities for builders and owners to design, build and sell green, net positive energy homes on city-owned parcels. "Energy positive" homes exceed LEED Platinum rating and supply excess energy to the grid. The City donates the land for development and provides subsidies to low-to-moderate income homebuyers. The E+ Program is an

initiative of the Boston Environment Department, the Department of Neighborhood Development, and the Boston Redevelopment Authority.

Arlington County Density Bonus

As mentioned above, Arlington County's Green Building Density Incentive Program allows escalating additional FAR for residential and commercial buildings that achieve LEED certification at different levels. An additional 0.025 FAR is available for projects achieving one of eight Arlington priority credits. Credit will be given for up to two credits. These priority credits include:

1. Optimize Energy Performance – at least 9% improvement over the LEED prerequisite
2. Enhanced Envelope Commissioning
3. Renewable Energy Production
4. Site Development – Protect or Restore Habitat
5. Bird Collision Deterrence Pilot Credit
6. Building Life-Cycle Impact Reduction

Seattle, Washington: FAR Bonus and Expedited Permitting

Seattle provides height and floor increases for projects achieving full Living Building Challenge (LBC) certification or Petal certification (if specific energy and water goals are met).

Additionally, Seattle's Priority Green program provides expedited permitting for projects pursing Built Green (4-Star or higher), LEED Gold or higher, LBC Petal or NZE Certification, or Passive House. The program expedites master use permits for projects that achieve at least 10 points on the Priority Green Facilitated Building Matrix, pursue the Living Building Pilot Program, meet the Seattle 2030 District performance targets, or achieve LEED Platinum/Built Green 5-Star.

Chicago, Illinois: Expedited Permitting

In Chicago, permit applications that include green technologies such as green roofs, rainwater harvesting, solar panels, solar thermal panels, wind turbines, and geothermal systems are required to be submitted through a Green Permit Program Project Administrator and are eligible for expedited permitting and potentially lower permit fees. Commercial projects must meet LEED certification, residential projects must certify under the Chicago Green Homes Program or LEED for Homes, and all projects must meet city "Green Menu" items.

San Diego, California: Expedited Permitting

San Diego offers expedited permitting for private projects that meet the city's Sustainable Building Policy by: achieving LEED Silver; reducing energy use by 15% below Title 24; reducing water use by 20%; using non-potable water for irrigation; and complying with the Construction and Demolition Ordinance.

San Francisco, California: Expedited Permitting

San Francisco provides expedited permitting for projects meeting LEED Platinum, GreenPoint Rated, LBC/Petal/NZE certification, Passive House or equivalent.

New York, New York: Tax Abatement

New York offers a 1-year tax abatement of $4.50 per square foot for green roofs and 5 to 8 ¾ percent tax relief for solar panel-related expenditures.

Cincinnati, Ohio: Tax Abatement

Cincinnati provides property tax abatements for residential and commercial buildings constructed or renovated to meet LEED certification standards.

Residential: 100% property tax abatement for 15 years (new construction) or 10 years (existing building retrofits) up to $275,000 for LEED Certified buildings; $400,000 for LEED Silver buildings; and $562,000 for LEED Gold buildings. There is no value limitation for structures that achieve LEED Platinum certification.

Commercial: 100% tax abatement (before payment in lieu of taxes) for 8-15 years depending on type and certification level. There is no cap on the value, except multi-unit residential buildings (4 units or more) are limited to $275,000 per dwelling unit. Owners must enter into an agreement with the local Board of Education district to pay the board an amount equal to 25% of the avoided property taxes, effectively making the tax abatement 75%. Additional provisions apply to commercial buildings using Community Reinvestment Area LEED abatements.

APPENDIX B: LEED Points Achieved

Data was provided to the consultant team on 14 projects that were certified under the LEED standard in Alexandria since the adoption of the Green Building Policy. Four of these projects were certified under LEED v2 and are not directly comparable to modern LEED projects; ten of these projects were certified under LEED v2009 and were analyzed for comparison to the policies proposed in this report. Below is a summary of LEED points achieved in water efficiency, stormwater management, energy optimization, renewable energy, commissioning and measurement and verification for the ten projects that pursued LEED 2009 under the Green Building Policy.

Table 14: LEED Points Achieved by Buildings in Alexandria Certified Using LEED v2009

LEED 2009															
Project Name	Certification?	Stormwater Design—Quality Control	Capture and treat 90% of avg annual rainfall (1 max)	Water Use Reduction	2 points=30% 3 points=35% 4 points=40%	Water efficient landscaping	Reduce by 50% for 1 point, 100% for 2 points, or No irrigation - 2 points.	Optimize Energy Performance (19 max)	% Better than 90.1 2007	On-Site Renewable Energy (7 max)	Percent Renewable	Enhanced Commissioning		Measurement and Verification	
James Polk Elementary	Gold (61/110)	1	90%	0/4	0%	4	100%	17/19	44%	7	13%	2		2	
Del Ray Tower	Silver (53/110)	0	0%	2	30%	2	50%	5	20%	0	0%	0		3	
Restaurant Depot	Certified (40/110	1	90%	0/4	0%	4	100%	9	28%	0	0%	0		0	
Braddock Metro Place	Certified (42/110	0	0%	2	30%	0	0%	8	26%	0	0%	0		0	
Potomoc Yard Landbay HI	Certified (44/110	0	0%	2	30%	4	100%	1	12%	0	0%	0		1	
Eisenower Ave Fire Station	Silver (54/110)	1	90%	3	35%	4	100%	2	14%	0	0%	2		1	
1620 Prince Street Hotel	Silver (52/110)	1	90%	0	0%	4	100%	7	24%		0%	2		1	
ACPS Jefferson-Houston	Gold (64/110)	0	0%	2	30%	4	100%	16	42%	0	0%	2		0	
Parc Meridien	Silver 50/110	1	90%	0	0%	2	50%	9	28%	0	0%	0		0	
VTS - Immanuel Chapel	Gold (62/110)	2	90%	0	0%	4	100%	15	40%	0	0%	2		0	
	LEED 2009	RESULT	6/10 PURSUED	AVERAGE	16%	AVERAGE	80%	AVERAGE	28%	RESULT	1/10 Pursued	RESULT	5/10 Pursued	RESULT	5/10 Pursued
	Certified = 3 Silver = 4 Gold =3			Better than base case		Reduction in potable water for irrigation		Better than ASHRAE 90.1 2007, Range = 14% - 44% note: 18% is mandatory now in LEED							

APPENDIX C: Impact Calculations

Setting Energy Standards

To both determine feasible energy and GHG standards, and to evaluate their impact, we began by developing a baseline of energy use intensities for different building types under different code standards.

Table 15: Existing and Anticipated Building Floor Area by Sector

Building Type	Existing Gross Floor Area (ft^2)	Gross Floor Area In development (ft^2)	Estimated Gross Floor Area Anticipated in Small Area Plans (ft^2)
Public Municipal	2.5 million	Under Review[93]	0.4 million[94]
Multifamily Residential	61.9 million	6.8 million	30.1 million
Office	21.8 million	1.7 million	15.7 million
Retail	11.4 million	362,000	4.4 million
Hotel	2.7 million	217,000	1.3 million
Other Commercial	1.9 million	317,000	0.7 million

To ensure we were making fair comparisons, all our data was sourced from the Pacific Northwest National Laboratory (PNNL) energy code studies. These studies are done at regular intervals to determine the average impact of new energy codes. Alexandria is within the 4A climate zone. All studies contain data for the 4A climate zone, using Baltimore as the baseline. To double check this was a fair comparison for Alexandria, we compared the number of Heating Degree Days (HDD) and Cooling Degree Days (CDD) for Alexandria and Baltimore and found only a 1% variance in HDD and a 4% variance in CDD between weather stations for both cities.

The table below lists the modeled EUIs for key building types for 90.1-2007, 90.1-2010, and 90.1-2013. 90.1-2007 is the baseline used for comparison under LEED v2009. Per the analysis in Appendix B, the median building built in Alexandria under the existing Green Building policy improved 26% over the 90.1-2007 baseline. LEED v4 references 90.1-2010. Virginia has adopted the new IECC 2015 energy code for commercial properties, without any weakening amendments. IECC 2015 uses 90.1-2013. While it will take a few years to be in effect for all projects, we can reasonably assume that new buildings that would be subject to any updated Green Building standard would be subject to this new energy code.

[93] Under review by the City.
[94] This is an estimate based on assuming that planned municipal buildings within Small Area Plan zones are the same size as existing typical City of Alexandria buildings of the same building type. We assumed that new fire stations are 13,000 ft2, new recreation centers and community buildings are 15,000-20,000 ft2, and new offices and civic buildings are 50,000 ft2.

Table 16: Typical EUIs (kBTU/ft2) by Building Type in Climate Zone 4A Under Various Code Baselines

Building Type	90.1-2007 (LEED v2009 baseline)	90.1-2010 (LEED v4 baseline)	90.1-2013 (IECC 2015)	New York Stretch Code	90.1-2016 (LEED 4.1 baseline)	Median projected achievement under existing green building policy (26% better than 90.1-2007)
Multifamily Housing	62.4	53.0	50.7	35.4	45.4*	46.1
Commercial (All)	71.9	59.2	54.6	45.7	54.9	53.2
Office	84.0	71.4	59.6	56.2	67.2*	62.2
School	52.2	44.4	36.7	30.2	36.6*	38.6
Retail	67.3	57.2	46.9	39.8	41.8*	49.8
Hotel	107.3	91.2	70.3	56.5	85.2*	79.4

*Building-type-specific EUIs were not available for 90.1-2016 at time of publication for climate zone 4A

This means that depending on the building type, the average commercial building will get between 2 and 9 points just for complying with the energy code, and the average multifamily building will nearly meet the LEED prerequisite of a 5% improvement.

Table 17: LEED Points Achieved by Compliance with VA Energy Code, and Assumed Fuel Breakdown

Building Type	Average EUI in 4A under LEED v4 baseline (90.1-2010)	Average EUI under new IECC 2015 / 90.1-2013 code	% improvement of new code over 90.1-2010	LEED points received just for code compliance	Assumed % electric (based on DC comparison for office and multifamily; PNNL data for other building types)	Assumed % Gas (based on DC comparison for office and multifamily; PNNL data for other building types)
Multifamily Housing	53.0	50.7	4%	0	100%	0%
Commercial (All)	59.2	54.6	8%	2	85%	15%
Office	71.4	59.6	17%	6	100%	0%
School	44.4	36.6	17%	6	85%	15%
Retail	57.2	46.9	18%	7	85%	15%
Hotel	91.2	70.2	23%	9	66%	34%

In order to ensure the new green building policy was stronger than the base code, it is thus necessary to require a higher level of performance, and to look at other standards being set by leading jurisdictions.

The Vancouver and Toronto standards referenced in Appendix A rely heavily on the concept of "Thermal Energy Demand Intensity," for which we had insufficient local data. However, the New York Stretch Code has had detailed modeling done for the 4A climate region, since New York City itself sits in 4A. (While NYC is climatically different than Alexandria, all PNNL modeling for climate zone 4A, including this one, uses Baltimore as a reference.)

While EUIs vary between different types of commercial buildings, for simplicity we recommend one threshold for all commercial buildings, with a separate threshold for schools. Hospitals, food-service establishments, data centers, and other high energy use buildings should be exempt from any strict EUI targets but should still be subject to similar percent improvement expectations. The following table lists the new proposed targets.

Table 18: EUI Recommendations

Building Type	EUI Recommend-ation	% improvement over 90.1-2010	% improvement over current energy code	% improvement over 90.1-2016	LEED v4 Optimize Energy Performance Points required	LEED v4.1 Optimize Energy Performance Points Required
Multifamily	35	34%	31%	23%	12	4
Commercial	45	30%	18%	18%	12	4
School	30	32%	18%	18%	12	4

Modeling Energy Use and GHG Impact

To model the impact of this policy, we looked at the amount of building forecast for Alexandria under the Small Area Plans, and projected what the EUI, total energy use, and total GHG emissions would be if those buildings were build to the IECC 2015 code. This was added to total citywide GHG emissions to estimate a BAU GHG emissions given grown in floor area.

We then estimated EUIs by building type based on the assumption of achieving a 30% improvement over the LEED v4 baseline of 90.1-2010 and calculated the policy scenario total energy use and GHG emissions.

The new EUI and energy performance targets will reduce the EUI of new buildings by between 18% and 33% depending on building type relative to the code and reduce the total energy use of the buildings forecast in the small area plans by 20%, and 592 billion BTU per year. The targets will reduce the GHGs from these buildings by over 63,000 metric tons per year; also 20% less than the BAU case. Compared to the current GHG emissions of Alexandria as a whole, and a BAU case where GHGs increase due to new construction but transportation emissions stay flat, these targets will reduce citywide GHG emissions by over 3%.

While this number does not sound significant, this is in line with the savings available for new construction policies in most jurisdictions. To take a particularly aggressive example, strategies for new construction included in the District of Columbia Clean Energy DC Plan are forecast to reduce citywide

GHGs by 4.6% relative to BAU. This is a similar order of magnitude as the savings forecast for Alexandria, but it is ~50% more impactful because DC controls its own energy code and is aiming for a net zero energy code by 2026, with EUI reductions ranging from 65% to 80% depending on building type.

Table 19: EUIs and Fuel Splits in BAU and Proposed Policy

Building Type	BAU EUI under new VA energy Code (kBtu/ft2)			Total EUI with LEEDv4 12 points (kBtu/ft2)		
	Total EUI	Electricity EUI	Gas EUI	Total EUI	Electricity EUI	Gas EUI
Multifamily	50.7	50.7	0.0	37.1	37.1	0.0
Office	56.0	56.0	0.0	50.0	50.0	0.0
Retail	46.9	39.8	7.0	40.0	34.0	6.0
Hotel	70.3	46.4	23.9	63.8	42.1	21.7
Other	54.6	46.4	8.2	41.4	35.2	6.2

GHGs for Alexandria were taken from the U.S. Environmental Protection Agency's eGRID 2016 data for the SRVC sub-region, which includes Northern Virginia; this is standard reference source used for Greenhouse Gas inventories.[95]

Table 20: Key Alexandria GHG metrics

Population	160,035
GHG Intensity Electric (tons/kBTU)	1.08E-04
GHG Intensity Gas (tons/kBTU)	5.31E-05
Citywide GHG, 2015	1.89E+06

Table 20: Energy Use from New Buildings Under BAU and Proposed Policy

Building Type	Floor Area	BAU Energy Use (kBtu)			Proposed Policy Energy Use (kBTU)		
		Total	Electricity	Gas	Total	Electricity	Gas
Multifamily	30,100,000	1.53E+09	1.53E+09	0.00E+00	1.12E+09	1.12E+09	0.00E+00
Office	15,652,611	8.77E+08	8.77E+08	0.00E+00	7.82E+08	7.82E+08	0.00E+00
Retail	4,392,742	2.06E+08	1.75E+08	3.09E+07	1.76E+08	1.50E+08	2.64E+07
Hotel	1,292,745	9.08E+07	5.99E+07	3.09E+07	8.25E+07	5.45E+07	2.81E+07
Other	3,761,902	2.06E+08	1.75E+08	3.08E+07	1.56E+08	1.33E+08	2.34E+07
Total	55,200,000	2.91E+09	2.81E+09	9.26E+07	2.31E+09	2.24E+09	7.78E+07
Avoided Energy					**-5.93E+08**		
Change in new construction energy/ GHG					**-20%**		

[95] https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

Table 21: GHG Emissions from New Buildings and Citywide Under BAU and Proposed Policy

Building Type	BAU GHG (tCO2e)	Proposed Policy GHG (tCO2e)
Multifamily	1.64E+05	1.20E+05
Office	9.44E+04	8.43E+04
Retail	2.05E+04	1.75E+04
Hotel	8.10E+03	7.36E+03
Other	2.05E+04	1.55E+04
Total	3.08E+05	2.45E+05
Avoided GHGs		-63,037
New Construction GHG Reduction		**-20%**
Citywide GHGs	2.20E+06	2.13E+06
Citywide GHG reduction		**-3%**

Modeling Water Use Impact

To calculate water impacts, we looked at the average Water Use Intensities (WUI) for major building types nationally, measured in gallons per sq. ft. per year.[96] Unlike with energy use or greenhouse gas emissions, these values do not vary significantly by geography or climate zone. The average energy use improvement over baseline achieved by buildings built under Alexandria's existing policy is 16% (see Appendix B). Our recommendation is that new buildings subject to the policy reduce their indoor water use by 40% relative to baseline. When applied across the forecast new floor area, this will avoid the use of at least 421 million gallons of water a year, or a 29% reduction in water use from new construction, relative to business as usual.

Table 22: Modeled Water Use Intensities

Building Type	National Average WUI	BAU WUI in Alexandria under current policy	Water Use Under New Policy
Multifamily	44.6	37.464	26.76
Office	14.6	12.264	8.76
Retail	12.6	10.584	7.56
Hotel	41.7	35.028	25.02
Other	20.3	17.052	12.18

[96] Commercial Building WUI numbers were sourced from the U.S. DOE 2012 Commercial Building Energy Survey: https://www.eia.gov/consumption/commercial/reports/2012/water/
Multifamily Building WUI numbers were source from a national survey conducted in 2012 by Fannie Mae: https://www.fanniemae.com/content/fact_sheet/energy-star-for-multifamily.pdf

Table 23: Water Use from New Buildings Under BAU and Proposed Policy

Building Type	Forecast New Floor Area	BAU Additional Water Use	Additional Water Use under New Policy
Multifamily	30,100,000	1,127,666,400	805,476,000
Office	15,652,611	191,963,621	137,116,872
Retail	4,392,742	46,492,781	33,209,130
Hotel	1,292,745	45,282,272	32,344,480
Other	3,761,902	64,147,953	45,819,966
Total	55,200,000	1,475,553,027	1,053,966,448
Avoided Water Use			421,586,579
Water Use Reduction vs. BAU in from new construction			-29%

Citywide water consumption figures were not available at the time of this report. However, if we assume that the multifamily and commercial buildings in Alexandria use water at the same rate as nationally, on average, then we can estimate that multifamily and commercial buildings in Alexandria currently use at least 3.37 billion gallons of water a year, and that the new policy will reduce the total water used by the multifamily and commercial sectors in Alexandria by 9% relative to BAU.

Table 24: Modeled Water Use from Buildings Under Current, BAU, and Proposed Policy

Building Type	Total Citywide Floor Area	Forecast New Floor Area	Current Modeled Commercial and Multifamily Water Use	BAU Commercial and MF Water Use	Commercial and MF Water Use under New Policy
Multifamily	61,900,000	30,100,000	2.76E+09	3.89E+09	3.57E+09
Office	21,846,868	15,652,611	3.19E+08	5.11E+08	4.56E+08
Retail	11,373,774	4,392,742	1.43E+08	1.90E+08	1.77E+08
Hotel	2,671,302	1,292,745	1.11E+08	1.57E+08	1.44E+08
Other	1,900,000	3,761,902	3.86E+07	1.03E+08	8.44E+07
Total	99,691,944	55,200,000	3.37E+09	4.85E+09	4.43E+09
Water Use Reduction vs. BAU in from new construction					9%

These water savings estimates are all underestimates, as they only account for reductions in indoor water use. The policy also has standards for reducing outdoor water use for irrigation. However, as reliable national metrics for irrigation water use were not available, the savings from these irrigation limits could not be calculated.