

IMPACT STATEMENT

Legislation title: Direct the Portland Housing Bureau to adopt an affordable housing Green Building Policy for new construction and rehabilitation (Ordinance)

Contact name: Victoria James

Contact phone: 503-823-3607

Presenter name: Victoria James

Purpose of proposed legislation and background information:

This legislation will instruct the Portland Housing Bureau (PHB) to adopt a green building policy for PHB owned buildings as well a newly constructed or rehabilitated buildings that use PHB funding for at least 10% of their total project cost and are over 20 units. This policy is aligned with the City's Green Building Policy and the Climate Action Plan.

Financial and Budget Impacts:

There is no direct impact to PHB's budget. PHB is working with the Portland State University Institute for Sustainable Solutions through the Climate Action Collaborative to verify that the requirements in this policy will not increase construction costs above the current LEED Gold standard. It is anticipated that the high-performance requirements for energy and water use will reduce utility costs during operations. Since fewer measures are required to meet the policy (energy, water and IAQ only) it is anticipated that soft costs for design, documentation, and certification will be reduced.

Community impacts and community involvement:

This policy will impact developers of buildings with 20 or more units that use PHB funding for at least 10% or more of the total project cost. The policy will decrease the City's energy use and increase the City's renewable energy use by requiring applicable affordable multifamily projects to meet targets for net Energy Use Intensity (EUI) with a long-term goal of getting to net zero energy. There may be a trickledown effect on the construction companies with whom the developers contract, in that the specific green building requirements are different. Finally tenants of PHB owned buildings and buildings that meet the green building requirements outlined above will be provided housing in higher performance buildings.

100% Renewable Goal Impacts:

The policy will decrease the City's energy use and increase the City's renewable energy use by requiring applicable affordable multifamily projects to meet targets for net Energy Use Intensity (EUI) with a long-term goal of getting to net zero energy.

Budgetary Impact Worksheet

Does this action change appropriations?

☐ YES

Please complete the information below.

☒ NO

You can skip this section

Moore-Love, Karla

From: Creager, Kurt
Sent: Friday, October 20, 2017 1:16 PM
To: Commissioner Fish; Wheeler, Mayor; Fritz, Amanda; Commissioner Eudaly; Commissioner Saltzman
Cc: Moore-Love, Karla; Schmanski, Sonia; Henderson, Maurice; Crail, Tim; Runkel, Marshall; Finn, Brendan; Alexander, Cupid; Valderrama, Andrea; Chisek, Kyle; Mena, Javier; Callahan, Shannon; Dinkelspiel, Karl; Zuniga, Suzanne; Anderson, Susan
Subject: Ordinance No. 1142 Green Building Policy Follow Up as Requested
Attachments: Commissioner Fish Letter_Ordinance_1142_Green Building Policy_10_20_2017.pdf; CostAnalysisGreen Building Policyfor Affordable Housing_PSU_10_2017.pdf

Dear Commissioner Fish; attached please find a letter responding on the record to your question about the difference in the proposed policy and past practice.

I am also providing an October, 2017 report from two researchers at PSU; Elliott T. Gail, Assistant Professor Mechanical and Materials Engineering and Liliana Caughman, Graduate Research Assistant, Environmental Science and Management.

Their Report: *Cost Analysis PHB Affordable Housing Green Building Policy* makes several promising conclusions:

- "...the net cost impact of the proposed policy ranges from a 5.1% reduction in cost to a 2.0% increase in cost with the midpoint estimate of 1.3% reduction." (ibid page 2);
- The new PHB policy moving from LEED V4 "gold" to "certified" as proposed, should provide a cost savings of approximately 2-6% depending on the building. (page 6); and
- When applied to three recently completed PHB-Funded projects; St. Francis Apartments, Abigail and Miracles Central, the midpoint of the range of cost savings was \$1,006,410.17. (pages 20-23).

While we anticipate modest savings from these new standards, some of the cost savings will given back or reinvested into the community by making the buildings 100% solar (Photo Voltaic-PV) ready and by supplying Electric Vehicle (EV) charging capability. Moreover, resident comfort and cost control over their personal finances will be greatly enhanced due to lower energy and water expenses.

Thank you for consideration of the materials provided before the second vote on Ordinance No. 1142.

Best Regards; Kurt

Kurt Creager
 Director
 Portland Housing Bureau

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188655

October 20, 2017

The Honorable Nick Fish, City Commissioner
1221 SW 4th Ave.
Portland, OR 97204

Re: Green Building Policy

Dear Commissioner Fish;

During Portland City Council deliberations on Ordinance No. 1142 on Wednesday October 18, 2017 you asked me to respond in writing as to how the new proposed Green Building policy would comport to or compare with the current policy in practice. The proposed Green Building Policy for Affordable Housing is not a lower standard than the City's current Leadership in Energy and Environmental Design (LEED) Gold policy. It maintains 3rd party certification of the highest performance targets for energy, water and indoor air quality that are embedded within LEED Gold.

While LEED and Earth Advantage offer numerous points for other green building strategies, this local policy focuses investments on the most cost effective strategies that bring the greatest benefit to multifamily housing, to get the greatest "bang for the buck" for building owners and residents. It eliminates the potential to "chase points" which is sometimes practiced within the design community to achieve LEED Gold by employing a large number of less important strategies at the expense of significant energy and water efficiency. This more focused approach also serves to reduce the documentation and administrative costs of higher level certifications.

In other words, this policy is designed to deliver greater benefit for less cost. Please do not hesitate to call or write with questions.

Best regards;

Kurt Creager, Director

Copy: City Commissioners

Moore-Love, Karla

From: Zuniga, Suzanne
Sent: Wednesday, October 18, 2017 3:12 PM
To: Moore-Love, Karla
Cc: Creager, Kurt; Dinkelspiel, Karl
Subject: RE: 1142 Green Building testimony

Hi Karla,

Please find the Cost Analysis of the PHB Green Building Policy for Affordable Housing attached. Please distribute and enter into the record for item 1142.

Thank You,
 suzanne

Suzanne Zuniga, AIA | Senior Construction Coordinator
Portland Housing Bureau
421 SW 6th Avenue, Suite 500
Portland, OR 97204
503.823.3280 direct



CostAnalysisGreen
 Building Pol...

From: Moore-Love, Karla
Sent: Wednesday, October 18, 2017 1:46 PM
To: Zuniga, Suzanne <Suzanne.Zuniga@portlandoregon.gov>; Commissioner Fish <nick@portlandoregon.gov>; Eudaly, Chloe <Chloe.Eudaly@portlandoregon.gov>; Fritz, Amanda <Amanda.Fritz@portlandoregon.gov>; Saltzman, Dan <Dan.Saltzman@portlandoregon.gov>; Wheeler, Ted <Ted.Wheeler@portlandoregon.gov>; Barber, Josiah <Josiah.Barber@portlandoregon.gov>; Brewster, Stacy <Stacy.Brewster@portlandoregon.gov>; Gates, Janine <Janine.Gates@portlandoregon.gov>; Quitugua, Betsy <Betsy.Quitugua@portlandoregon.gov>; Washington, Mustafa <Mustafa.Washington@portlandoregon.gov>
Subject: 1142 Green Building testimony

<< Message: Testimony supporting the proposed PHB green building policy >> << Message: Ordinance regarding PHB Green Building Policy >> << Message: Testimony in Support of PHB's Green Building Policy >> << Message: Portland Housing Bureau Green Policy Hearing - Testimony >>

Karla Moore-Love | Council Clerk
 Office of the City Auditor | City Hall Rm 130
 503.823.4086

Cost Analysis: PHB Affordable Housing Green Building Policy

Liliana Caughman, Graduate Research Assistant, Environmental Science & Management,
Portland State University

Elliott T. Gall, Assistant Professor, Mechanical and Materials Engineering, Portland State
University

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1. Overview

This document is a high-level overview of potential costs associated with implementing the proposed Portland Housing Bureau (PHB) Affordable Housing Green Building Policy as compared to the previous policy. Please keep in mind that project costs are highly variable and the best way to understand the financial impacts of this policy will be monitoring costs moving forward. Currently there is not enough data to fully understand the costs of the new LEED v4 (BD + C) for homes standards and therefore it cannot be completely compared to the new PHB policy. Additionally, there limited data describing costs associated with some of the more progressive targets of the new PHB policy. Therefore, the following report describes estimates and should only be used for general insight and not financial planning.

2. Executive Summary

The Portland Housing Bureau is proposing updates to its Affordable Housing Policy (AHP). These updates will affect the manner in which many affordable housing projects are designed, built, and operated, with commensurate impacts to cost. This document presents a methodology and quantitative summary of the cost impacts associated with the proposed changes. An analysis of the proposed AHP was conducted and changes in the proposed policy (relevant to building design, construction, operation, etc.) from that the previous policy were identified. Appropriate, quantitative cost impacts for each change were estimated from a literature review of academic research and industry case studies, and communication with local green building consultants and the Portland Housing Bureau. Cost impacts were normalized where possible and appropriate to quantifiable building parameters (e.g., square footage) and a net cost impact equation was developed. This equation enables estimation of the change in cost of a project (described in terms of key building characteristics) due to the project meeting the proposed AHP. The net cost equation was applied to three recently constructed PHB Affordable Housing projects, showing the **net cost impact of the proposed policy ranges from a 5.1% reduction in cost to a 2.0% increase in cost, with a midpoint estimate of 1.3% reduction**. However, *these estimates are subject to substantial uncertainty* — potential cost changes are likely to be highly variable across projects as impacts in one project may not be realized in other projects for many reasons. Thus, it is recommended that further investigation of these estimates be undertaken to continue to refine the presented methodology as well as to initiate collection of affordable housing project data and metadata that will inform future models and support development of best practices.

3. Policy Cost Comparison

The new PHB policy will require all new applicable buildings to meet either LEED v4 “certified” or Earth Advantage Multifamily (EA) “silver” certification levels. Additionally, the buildings will need to meet specific performance targets focused primarily on 1) energy usage (NET EUI), 2) water consumption, and 3) indoor air quality. The previous policy required all applicable buildings to meet LEED v4 “gold” or EA Multifamily “gold” certification standards. Reducing

requirements from “gold” certification to “basic” certification will represent a cost decrease in many cases, however some additional requirements of the new policy represent probable cost increases. The balance of these costs will vary widely from project to project. A summary of the comparison of the expected costs of proposed PHB policy is shown in Table 1.

Table 1. Summary of potential impacts to cost as a result of the proposed PHB Affordable Housing policy.

Proposed policy item	Likely cost impact	Coefficient variable	Likely cost magnitude (value of coefficient is in parenthesis)
E.1.a – New construction certification	Reduction	A (%)	Moderate to Very High (0.5%-6% of total project costs, or \$3-\$5/ft ²)
E.1.b.1 – Energy consumption	Increase	B	High (\$7,000 per 1 kBtu/ft ² reduction in EUI)
Policy E.1.b.2 – Solar Energy	Increase		Very Small (<\$2,500, fixed cost)
Policy E.1.b.3 – EV Charging	Increase	C	Small-Moderate (~\$2,500 - \$9,000/parking space with EV charging)
Policy E.1.b.4 – Multifamily program registration	No change		-
Policy E.1.c – Water consumption	Increase	D	Small-Moderate (~\$200/unit)
Policy E.1.d.1 – Indoor air quality/health	No change		-
Policy E.1.d.2 – Ventilation and Fresh Air	Increase	E	Moderate to High (0.6-1.2 \$/ft ² , kitchen and bathroom square footage)
Policy E.1.e.1 – Baseline requirements: Design	Increase		Moderate to High (\$5,000-\$25,000, fixed cost)
Policy E.1.e.2 - Baseline requirements: Construction	Increase	F	Small (0.06-1 \$/ft ²)
Policy E.1.e.2 - Baseline requirements: Third party commissioning	Increase	G	Moderate (0.2-1% of construction costs)
(Policy E.1.e.2) - Baseline requirements: Operations	Increase	H	Moderate (0.2-1% of construction costs), assumed same as third-party commissioning)

The conclusions summarized in Table 1 are the result of conversations with the Portland Housing Bureau, local (Portland, OR) Green Building Consultants, and literature review. Further details regarding the rationale of each item in Table 1 can be found in the subsequent analysis

of each component of the proposed PHB Affordable Housing Policy (Section 4). Note also that the policy cost is an attempt for a conservative estimate of the cost impact. For example, under the scenario where a LEED v4 or EA credit has moved from required in the previous policy to optional under the new policy, we compare the scenario where the credit would have been pursued under the previous policy and is presently not pursued.

The available data regarding cost impacts of the proposed PHB policy was, where appropriate and possible, transformed to provide a scalable coefficient that is normalized to an appropriate unit. For example, the cost estimate for reduction in cost due to relaxing the requirements for green building certification (coefficient A) remains in terms of percentage of total project costs. Other factors are scaled appropriate to the relevant aspect of the proposed affordable housing policy. These scaled factors can be combined into a total net cost impact equation, shown below, that can be used to estimate cost impacts across a broad range of projects.

Net cost impact equation:

$$\begin{aligned}
 \text{Cost} = & A(\text{total project costs } \$) \\
 & + B(\text{necessary EUI reduction from solar}) \\
 & + C(\text{\#of parking spaces with EV charging}) \\
 & + D(\text{\#of units}) + E(\text{total sq.ft. of balconies and kitchens}) \\
 & + F(\text{total sq.ft.}) + G(\text{construction costs}) \times 2 \\
 & + [\text{\$7,500 to \$27,500 fixed costs}]
 \end{aligned}$$

The Portland Housing Bureau provided information on three recently constructed affordable housing buildings (St. Francis, Abigail, Miracles Central) to conduct cost impact assessments according to the previously determined “net cost impact equation”. **Note that negative values indicate cost savings are realized from the proposed PHB policy while positive values indicate additional costs.** For coefficients with ranges, as shown in Table 1, the low and high values from the literature review were used to create the widest possible range of estimates. That is, the “low” scenario is the most optimistic with respect to possible cost savings, and assumes that reduction in costs are high ($A = 6\%$) while contributors to increased cost are taken as their lowest values. Conversely, the “high” scenario estimates assumes the most pessimistic scenario for cost savings, where reduction in cost is low ($A = 0.5\%$) while contributors to increased cost impacts are their highest values. A third scenario considers the “midpoint”, and is determined by calculating the average of the high and low value found in the literature review (where high and low values were obtained). A summary of the analysis is shown in Figure 1, where the bars represent the midpoint value, and the error bars span the range of the “low” and “high” scenarios. A full accounting of the cost analysis for each of the three analyzed buildings can be found in Appendix A.

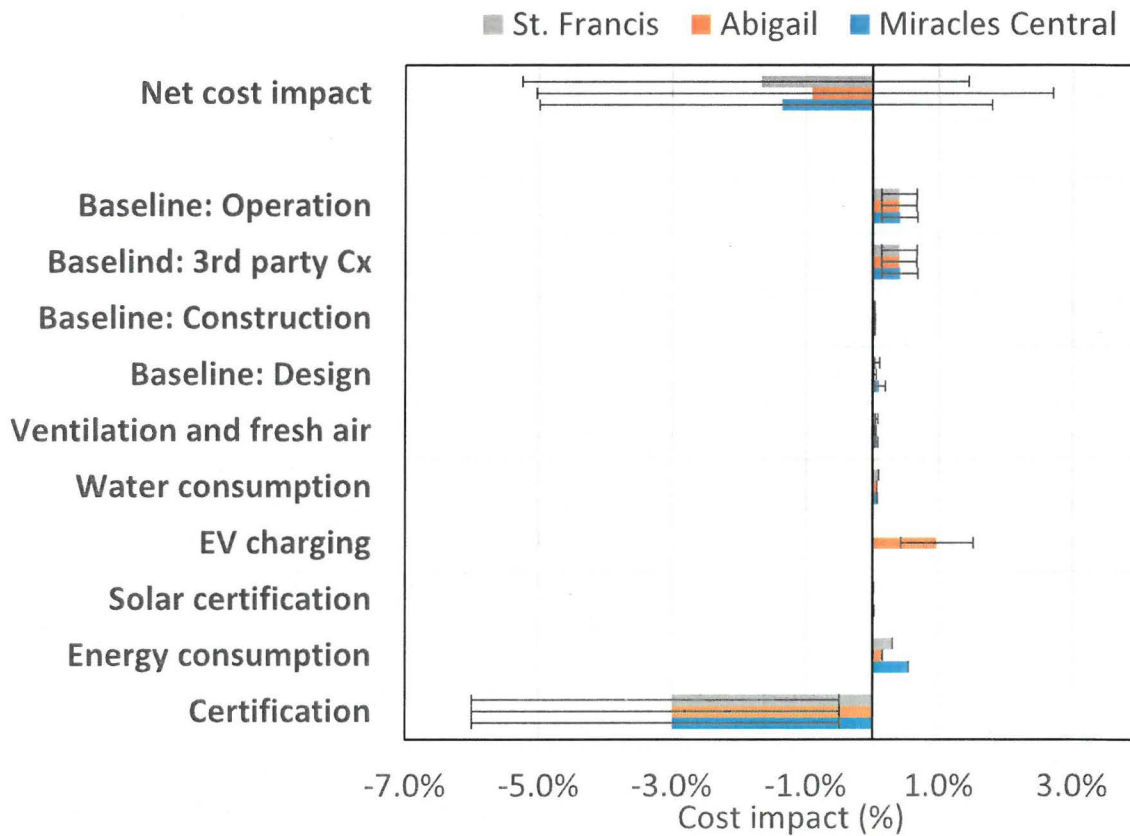


Figure 1. Summary of cost comparison of impact of proposed PHB affordable housing policy using three recently completed projects as case studies. Bars represent the “midpoint” estimate, where high and low values of cost coefficients were averaged. Error bars represent the “low” and “high” estimates, which span the range of optimistic and pessimistic cost savings scenarios, respectively.

4. Analysis of cost impacts due to proposed PHB policy to inform cost estimates

Certification

(policy E.1.a)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
LEED V4 Certified or EA Multifamily	LEED V4 Gold or EA Gold	<ul style="list-style-type: none"> It is estimated that LEED v4 NC costs 0-1% over standard construction costs to reach “certification”, 1-4% for “silver”, 3-6% for “gold”, and >5% for “platinum” (Skanska Consultants, 2015; City of Portland OMF, 2015) In terms of square footage, previous estimates put the premium of green building at about \$3-\$5/ft² (Kats, G. Green Buildings Costs and Financial Benefits. Massachusetts Technology Collaborative, 2003.) Therefore, the new PHB policy moving from LEED V4 “gold” to “certified” should provide a cost savings of approximately 2-6%, depending on the building. EA “gold” and LEED V4 “gold” standards are different, but comparable, and therefore cost changes are likely similar (Earth Advantage Consultants, 2017). EA “gold” certification may represent an incremental cost of as low as 0.5% over standard construction practices. (Earth Advantage Consultants, 2017). If costs for the other parts of the new PHB policy can be limited to only 2-6% above standard practice costs, then the old policy and new policy can be expected to cost about the same.

Energy

Energy Consumption

(Policy E.1.b.1)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
<p>Net EUI targets</p> <p>Goals = 30 in 2017 28 in 2020</p>	<p>EUI targets</p> <p>LEED v4 estimated EUI 32-36</p> <p>EA estimated EUI 34 - 36</p> <p>(Earth Advantage Consultants, 2017)</p>	<ul style="list-style-type: none"> The new PHB policy looks at "Net EUI", where the previous policy considers "EUI". This makes it difficult to compare. The new requirements are much lower than anything expected from any level of LEED V4 or EA certification (Earth Advantage Consultants, 2017). However because of the difference between considering Net EUI and gross EUI a direct cost comparison cannot be made. Buildings would likely need significant amounts of renewable energy to meet the new PHB targets. This would also require aggressively implementing many LEED V4 and EA energy saving methods, probably at the gold level. Overall, it will require more cost and effort to achieve new PHB requirements (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). As a point of comparison, the Bullitt Center installed a 28 kW system that reduced their EUI by 20 kBtu/ft² (Bullitt Center, 2013). At a typical installed price of ~\$5 per watt (Solar Power Authority, 2016; BuildingGreen, 2015), this system would have a present day installed cost of around \$140,000. This means a rough estimate of the cost of meeting EUI reduction by way of solar would be \$7,000 per 1 kBtu/ft² reduction in EUI. Reducing EUI from 34 to the 2017 goal of 30 would thus cost approximately \$28,000. <p>It is worth noting that relaxing the LEED V4 certification may affect the relevant EUI for comparison. For example, the Average Site EUI for multi-family construction with 5 units or more is 40. (Architecture 2030 Challenge)</p>

Solar Energy

(Policy E.1.b.2)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
Solar Feasibility study required	Not required	<ul style="list-style-type: none"> This likely represents a cost increase, as it is not mandated for LEED V4 or EA certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). A rough estimate from a company advertising solar panel analysis is \$400 for a Level 2 analysis, which includes load profile, load analysis, shading analysis, PV system sizing, and financial assessment and modelling (SolarWise WW, 2016) The Energy Trust of Oregon can fund solar feasibility studies, reducing this cost impact.
If qualified, constructed with solar energy system or Solar Ready	Not required	<ul style="list-style-type: none"> This likely represents a cost increase, as it is not mandated for LEED V4 or EA certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). Additionally, in order to meet NET EUI outcomes of PHB policy, solar will likely need to be installed which is an additional cost. Construction of solar is about \$4-5/W (BuildingGreen, 2015).

EV Charging

(Policy E.1.b.3)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
Electric Vehicle Charging stations at 4% or EV ready at 10% of spaces	Not required	<ul style="list-style-type: none"> This likely represents a cost increase, as it is not mandated for LEED V4 or EA certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). Electric vehicle supply equipment (EVSE) costs around \$2,500-\$9,000 per space (Building Green, 2015; GreenBiz, 2014).
Size electric capacity for Level 2 charge to vehicles in 20% of parking spaces where possible	Not required	<ul style="list-style-type: none"> This likely represents a cost increase, as it is not mandated for LEED V4 or EA certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016).

Multifamily Program Registration

(Policy E.1.b.4)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
Register project with Energy Trust of Oregon	Not required	<ul style="list-style-type: none"> The cost of registration will be covered by the Energy Trust of Oregon. Therefore no associated cost increase.

Water

Water Consumption

(Policy E.1.c)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
Meet water reductions targets (i.e. 28% in 2017, 30% in 2020)	Variable credits and targets	<ul style="list-style-type: none"> • LEED V4 NC has a methodology for reducing indoor water consumption significantly and could be achieved at the LEED V4 “certified” level (BuildingGreen Inc., 2015). EA certification has similar methods of achieving water reduction (Earth Advantage Consultants, 2017). • Therefore, depending on the project and how they choose to achieve LEED V4 or EA credits, this could represent no additional costs. • It will likely cost \$200+ per unit above standard construction costs to achieve desired reductions, in line with LEED V4 requirement (BuildingGreen Inc, 2015).

Indoor Air Quality/Health

Clean Air

(Policy E.1.d.1)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
a) Interior paints etc.CA 01350 or SCAQMD 113	LEED V4 - same standard, elective EA - required 150 gpl or less, 50 gpl or less is elective	<ul style="list-style-type: none"> • LEED v4 BD+C New Construction. The determination of whether a financial cost will be incurred depends on whether the specific project opts to comply with this portion of the LEED V4 standard to obtain points (3 possible points). However, given that the new PHB policy requires what was previously optional, <i>it likely represents a small cost increase, but is a negligible premium (BuildingGreen Inc, 2015; PHB, 2017).</i> • EA Multifamily The EA requirement of 150 grams/L is the same as the VOC content limit for architectural coatings in the “nonflat high gloss coating” from SCAQMD 113 (CARB, 2007). Any use of “flat” or “nonflat” category coatings would require limits of 50 grams/L or 100 grams/L respectively under SCAQMD 113 (CARB, 2007). Thus, the new requirement is likely to represent a small cost increase but is considered a negligible premium (BuildingGreen Inc, 2015; PHB, 2017).
b) Composite wood - CA EPA Air Resource Board requirements	LEED V4 - same standard, elective EA - No Added Urea Formaldehyde (NAUF) standards elective	<p>LEED v4 BD+C New Construction and EA Multifamily.</p> <ul style="list-style-type: none"> • The determination of whether a financial cost will be incurred depends on whether the baseline for comparison opts to comply with this portion of the LEED V4 standard to obtain points (3 possible points) or the relevant measures identified in EA MF 2012 (various optional health points). However, given that the new PHB policy requires what is optional in meeting LEED V4 and/or EAMF standards, <i>it likely represents a small cost increase.</i>

c) Smoke free	<p>LEED V4 - No tobacco in common areas required</p> <p>EA - No smoking or vaping, elective</p>	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> A required component for LEED V4 certification is to implement a plan to “prevent or minimize exposure of building occupants... to environmental tobacco smoke”. The proposed PHB guideline is similar in scope to that of LEED V4, therefore it is plausible that this component does not represent a cost increase. <p>EA Multifamily</p> <ul style="list-style-type: none"> No mention of a smoking policy is made within the EAMF 2012 guidelines. Therefore, implementation of a smoke-free policy for projects that previously met EAMF certification will represent a cost increase.
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Ventilation and Fresh Air

(Policy E.1.d.2)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
a) Supply and exhaust balanced	Not required	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> LEED v4 BD+C requires a minimum indoor air quality performance that includes several options for meeting ventilation and monitoring standards. For projects inside the U.S., ASHRAE Standard 62.1 is referenced, which requires that balancing of systems and equipment be documented (Section 7.2.2 of ASHRAE 62.1) ASHRAE, 2010). Therefore, it is likely that the requirement of the proposed PHB policy does not represent a cost increase for those projects that previously obtained LEED V4 certification. <p>EA Multifamily</p> <ul style="list-style-type: none"> EA Multifamily does not specifically require that supply and exhaust ventilation be balanced. Mechanical ventilation is required (EAMF 5.2). The only required measure is that fans in baths meet energy star and 62.2 requirements - this represents

		an exhaust ventilation strategy. Therefore, a balanced supply and exhaust approach would represent a cost increase.
b) Exhaust from bathroom and kitchens to outdoors	<p>Bathroom exhaust directly to outside and provided code permits, kitchen may have recirculations hoods so long as requisite kitchen air-changes is provided by port located in proximity</p> <p>Intake exhaust separation of a minimum 10 ft required for plumbing stacks, commercial hood and vehicle ducted exhaust ducts relative to fresh-air intakes</p>	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> LEED v4 BD+C stipulates that the minimum IAQ performance include meetings ASHRAE 62.1. This standard specifies that a dwelling unit have 5 cfm/person of ventilation air as well as exhaust ventilation at kitchens and bathrooms. However, makeup air may be recirculation air, outdoor air, or transfer air. Therefore, it is not strictly required that air from kitchens or bathrooms be exhausted to the outdoors to be in compliance with ASHRAE 62.1. Therefore, this aspect of the proposed PHB guideline likely represents a cost increase compared to the current standard. (Note that ASHRAE 62.2 requires that exhaust from kitchens and bathrooms are routed to outdoors.) <p>EA Multifamily</p> <ul style="list-style-type: none"> EA Multifamily requires that both bathrooms (5.2.4) and kitchen exhaust fans (5.2.6) be exhausted to remove odors and moisture from the living space of homes. An EA rater must confirm that the flowrates required in ASHRAE 62.2 are met. Additional costs from exhaust systems that vent to outdoors are on the order of 0.6-1.2 \$/ft² of space needing exhaust (assumed 0.5 cfm/ft²) (BuildingGreen Inc, 2015).
c) ASHRAE 62.2-2010	<p>Required for residential</p> <p>(meet 62.1-2010 non-residential)</p>	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> LEED v4 NC does not mandate that the building must meet ASHRAE 62.2., rather ASHRAE 62.1-2010 is an optional path for compliance. This likely represents a cost increase, as there are additional requirements in 62.2 for residences (dedicated exhaust in each kitchens and bathrooms) that are not necessarily present in 62.1-2010.

		<ul style="list-style-type: none"> Note that LEED v4 for Homes Midrise references ASHRAE 62.2, and so this requirement does not represent a material change for those projects meeting this LEED standard. <p>EA Multifamily</p> <ul style="list-style-type: none"> This likely does not represent a cost increase over EA Multifamily, as previously noted in E.1.d.2.b, it is already required in EA Multifamily that bathrooms and kitchens be exhausted.
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Baseline Requirements

Design

(Policy E.1.e.1)

Proposed PHB Policy	Previous Policy	Financial Changes & Notes
a) Eco-charrette	Elective credit	<ul style="list-style-type: none"> Currently “eco-charrette” an elective credit in LEED and EA, but in LEED v4 NC it is “highly recommended” (BuildingGreen Inc, 2015). Not all projects elect to complete the eco-charrette while gaining certification, but for those that do it will likely represent a neutral cost. For those who would not have completed the eco-charrette, it represents a cost increase. Although it has the benefit of gaining certification points while also meeting new PHB policy requirements. Design process of eco-charrette estimated to cost 28-53 work hours and specialized studies can cost \$5,000 to upwards of \$40,000 per topic (BuildingGreen Inc, 2015).

		<ul style="list-style-type: none"> PHB is considering a 4-8 hour eco-charrette, which will likely be covered by the Energy Trust of Oregon, up until a point (PHB, 2017)
b) Cost/benefit analysis	Elective credit or not required	<ul style="list-style-type: none"> This is currently an elective for EA and not required for LEED V4 (Earth Advantage Consultants, 2017). This likely represents a cost increase for most buildings. Portland Housing Bureau is working towards the roll-out of a life cycle cost analysis tool, developed from a federal program. This tool will help automate the process such that input from relevant team members, on the order of 40 h total, should be able to accomplish this task. Therefore, relatively minor cost increase (\$5,000-10,000). (PHB, 2017)
c) Coordination with asset management	Required	<ul style="list-style-type: none"> New PHB requirement is not substantially different from both EA and LEED V4 requirements (Earth Advantage Consultants, 2017). This likely represents little to no cost increase depending on the project.
d) Coordination of contract documents	Required	<ul style="list-style-type: none"> No cost increase. Same as LEED V4 and EA requirements (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016).

Construction

(Policy E.1.e.2)

New PHB Policy	Previous Policy	Financial Changes & Notes
a) Pre Construction meeting	LEED V4 - not required but a best practice EA - required	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> The present guideline stipulates a preconstruction meeting as a non-required best practice. Preconstruction meetings are typically included as part of the standard procedure, and therefore it is unlikely this represents a change in cost from the previous practice (PHB, 2017) <p>EA Multifamily</p> <ul style="list-style-type: none"> A preconstruction meeting is required to obtain EAMF certification (1.1.17). Therefore, this does not represent a cost increase.
b) Periodic testing and inspection	Not required	<p>LEED v4 BD+C New Construction.</p> <ul style="list-style-type: none"> The present guideline does not require much of the testing and inspections described in PHB E.1.e.2(b)(i-v), however, much of the stated inspections are typical practice in PHB affordable housing stock (PHB, 2017). Therefore it is thought that the stipulation of this requirement may lead to only a minor cost increase. Rough cost of inspection taking from discussions online at International Association of Certified Home Inspectors (https://www.nachi.org/forum/f53/much-do-you-charge-commercial-inspection-48729/) Note that LEED v4 for Homes Midrise requires testing and inspection that is similar in scope to the testing and inspection requirements outlined in PHB E.1.e.2(b)(i-v). <p>EA Multifamily</p> <ul style="list-style-type: none"> EAMF 2012 includes several required measures that are similar in scope to the testing and inspection requirements outlined in PHB E.1.e.2(b)(i-v), for example the energy modeling described in EAMF 1.1.18 includes performance testing that requires blower door testing, although the guidance in the PHB guideline is more prescriptive. These requirements are expected to be maintained in the forthcoming version of EAMF (Earth Advantage Consultants, 2017)

Third Party Commissioning

(Policy E.1.e.3)

New PHB Policy	Previous Policy	Financial Changes & Notes
<p>a) Document project requirements</p> <p>b) Incorporate commissioning requirements into construction documents</p> <p>c) Develop and Utilize commissioning plan</p> <p>d) Verification</p> <p>e) Commissioning report to PHB</p>	<p>LEED V4 - required or elective</p> <p>EA - required</p>	<ul style="list-style-type: none"> Some verification is required for LEED V4 or EA certification, but each varies from the new PHB policy (Earth Advantage Consultants, 2017; LEED V4 Requirements, 2016). LEED v4 NC has commissioning requirements under the Fundamental commissioning and verification point (required). . For some projects the PHB commissioning requirement will aid in achieving LEED and EAS certification. Overall, this likely represents an added cost of the new PHB requirements over LEED V4, however it is only slightly more than EA requirements. “Commissioning fees generally start around \$5,000–\$7,500 for smaller, less complex projects, such as a core/shell office or retail up to around 15,000 ft², or a tenant fit-up up to about 12,000 ft². According to NIBS Guideline 3, projects with construction budgets over \$20 million typically require 0.2% of the construction budget for BECx, or \$40,000 for a \$20 million project. Projects with budgets under \$20 million may see that percentage rise, ranging from 0.3% to 1%, or \$30,000–\$100,000 for BECx on a \$10 million building.” (BuildingGreen Inc, 2015)

Operations

(Policy E.1.e.3)

New PHB Policy	Previous Policy	Financial Changes & Notes
a) Third party commissioning at year 7	Not required	<ul style="list-style-type: none"> Year 7 commissioning not required for EA or LEED V4 certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). Represents a cost increase of new PHB policy. See commissioning costs from Policy E.1.e.3.a
b) Operations and maintenance trainings	Elective credit	<ul style="list-style-type: none"> This requirement is elective for EA and LEED V4 certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). PHB believes that this is standard practice on projects and does not represent an additional undertaking compared to the previous guideline (PHB, 2017)
c) O&M Manual	Elective credit in LEED and EA (slightly different standards)	<ul style="list-style-type: none"> This requirement is elective for EA and LEED V4 certification (Earth Advantage Consultants, 2017; LEED v4 Requirements, 2016). Since it can help achieve certification, it may or may not represent increase in cost, depending on the project.
d) Tenant Education	Required.	<ul style="list-style-type: none"> No cost increase, required by all (Earth Advantage Consultants, 2017).

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Appendix A: Analysis of three buildings

Miracles Central

- Total cost: \$12,942,002
- Modeled (or actual) site EUI: not certified (code) (modeled EUI = 40)
- total # of parking spots: 0
- # of units: 47
- square footage of bathroom and kitchen per unit: Bath 80 SF Kitchen: 112 SF
- total project square footage: 48,351 Building Gross SF
- construction costs: \$8,799,971

Project 1		Miracles Central			
Total Cost	\$	12,942,002.00			
Site EUI		40			
# of parking spots		0			
# of units		47			
bath/kitchen sq. ft./unit		192			
project sq. ft		48351			
const. costs	\$	8,799,971.00			
		Midpoint	Low	High	
Certification	\$	(388,260.06)	\$ (776,520.12)	\$	(64,710.01)
Energy consumption	\$	70,000.00	\$ 70,000.00	\$	70,000.00
Solar certification	\$	2,500.00	\$ 2,500.00	\$	2,500.00
EV charging	\$	-			
Water consumption	\$	9,400.00	\$ 9,400.00	\$	9,400.00
Ventilation and fresh air	\$	8,121.60	\$ 5,414.40	\$	10,828.80
Baseline: Design	\$	12,500.00	\$ 5,000.00	\$	25,000.00
Baseline: Construction	\$	3,868.08	\$ 2,901.06	\$	4,835.10
Baseline: 3rd party Cx	\$	52,799.83	\$ 17,599.94	\$	87,999.71
Baseline: Operation	\$	52,799.83	\$ 17,599.94	\$	87,999.71
Net cost impact	\$	(176,270.73)	\$ (646,104.78)		\$233,853.31
% cost impact		-1.4%	-5.0%		1.8%

Abigail

- Total cost: \$47,932,537
- Modeled (or actual) site EUI: LEED Gold (modeled EUI = 40)
- total # of parking spots: 81
- # of units: 155
- square footage of bathroom and kitchen per unit: Bath 70 SF Kitchen: 70 SF
- total project square footage: 187,411 SF
- construction costs: \$31,924,469

Project 2		Abigail		
Total Cost	\$	47,932,537.00		
Site EUI		40		
# of parking spots		81		
# of units		155		
bath/kitchen sq. ft./unit		140		
project sq. ft		187411		
const. costs	\$	31,924,469.00		
		Midpoint	Low	High
Certification	\$	(1,437,976.11)	\$ (2,875,952.22)	\$ (239,662.69)
Energy consumption	\$	70,000.00	\$ 70,000.00	\$ 70,000.00
Solar certification	\$	2,500.00	\$ 2,500.00	\$ 2,500.00
EV charging	\$	465,750.00	\$ 202,500.00	\$ 729,000.00
Water consumption	\$	31,000.00	\$ 31,000.00	\$ 31,000.00
Ventilation and fresh air	\$	19,530.00	\$ 13,020.00	\$ 26,040.00
Baseline: Design	\$	12,500.00	\$ 5,000.00	\$ 25,000.00
Baseline: Construction	\$	14,992.88	\$ 11,244.66	\$ 18,741.10
Baseline: 3rd party comm.	\$	191,546.81	\$ 63,848.94	\$ 319,244.69
Baseline: Operation	\$	191,546.81	\$ 63,848.94	\$ 319,244.69
Net cost impact	\$	(438,609.60)	\$ (2,412,989.68)	\$ 1,301,107.80
% cost impact		-0.9%	-5.0%	2.7%

St Francis

- Total cost: \$23,548,327
- Modeled (or actual) site EUI: LEED Gold (modeled EUI = 40)
- total # of parking spots: 0
- # of units: 106
- square footage of bathroom and kitchen per unit: Bath 60 SF Kitchen: 87 SF
- total project square footage: 72,055 SF
- construction costs: \$15,744,314

Project 3		St. Francis		
Total Cost	\$	23,548,327.00		
Site EUI		40		
# of parking spots		0		
# of units		106		
bath/kitchen sq. ft./unit		147		
project sq. ft		72,055		
const. costs	\$	15,744,314.00		
		Midpoint	Low	High
Certification	\$	(706,449.81)	\$ (1,412,899.62)	\$ (117,741.64)
Energy consumption	\$	70,000.00	\$ 70,000.00	\$ 70,000.00
Solar certification	\$	2,500.00	\$ 2,500.00	\$ 2,500.00
EV charging	\$	-		
Water consumption	\$	21,200.00	\$ 21,200.00	\$ 21,200.00
Ventilation and fresh air	\$	14,023.80	\$ 9,349.20	\$ 18,698.40
Baseline: Design	\$	12,500.00	\$ 5,000.00	\$ 25,000.00
Baseline: Construction	\$	5,764.40	\$ 4,323.30	\$ 7,205.50
Baseline: 3rd party comm.	\$	94,465.88	\$ 31,488.63	\$ 157,443.14
Baseline: Operation	\$	94,465.88	\$ 31,488.63	\$ 157,443.14
Net cost impact	\$	(391,529.84)	\$ (1,237,549.86)	\$ 341,748.55
% cost impact		-1.7%	-5.3%	1.5%

Final numbers indicated cost changes between -5.2% to +1.9% with a midpoint of -1.4%