A Technical Analysis of Innovation and Adaptation for a Whole Building Utility Offering

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ABSTRACT

In recent years, building owners and developers have faced unprecedented challenges, including labor shortages, construction cost increases, and supply chain issues. At the same time, energy codes, public policies, and resiliency targets have continued to push design teams toward net zero goals and stretched strained budgets even further. This has created the need for innovative utility programs that can offer resources and incentive funding for a holistic approach to energy-efficient building design and construction.

With over a decade of success, the Energy Trust New Buildings program continues to innovate and adapt to changing energy codes and market needs. In 2019, the Program design was updated to reflect that Oregon adopted ASHRAE 90.1-2016 for commercial buildings. The Whole Building offering is now based on Appendix G and the Performance Rating Method (PRM). This required approval from the Oregon Public Utility Commission (OPUC) to eliminate the requirement of measure-by-measure cost effectiveness analysis for the Whole Building offering.

While alignment with Appendix G reduced the burden on participants and encouraged a holistic approach, it required development of a tool that could estimate both electric and natural gas energy savings based on the modeling results. Since this major change, participation in the offering increased by 140% but created other considerations. We will look at the lessons learned to overcome challenges from these offering changes and how the technical tools and resources continue to evolve to address both program and project needs.

Introduction

Energy Trust of Oregon is an independent nonprofit dedicated to providing energy efficiency and renewable energy services and incentives for electric and natural gas customers of five investor-owned utilities. Energy Trust's New Buildings program (New Buildings or Program) provides incentives and technical support to new construction, major renovation, and tenant improvement projects, across all commercial building types, including Multifamily. CLEAResult has served as the Program Management Contractor for New Buildings since 2009.

New Buildings is a market transformation program. Through early engagement with design teams, the incentives offered for technical assistance and building systems continue to advance creativity and innovation in new construction and major renovation projects. Maintaining this position in the marketplace requires a commitment to continuous program improvement and participant input, as well as internal innovation to develop technical tools and functional strategies to implement a complex and trailblazing program.

Modeled Savings and Path to Net Zero

New Buildings has supported a holistic approach to building design since 2004, by modeling energy consumption using a baseline meeting the 2007 Oregon energy code (based on

IECC). The Program developed a set of program technical guidelines that established the process by which measures were evaluated individually. New Buildings used a Savings Summary Worksheet tool to handle impacts of interactive effects of measures, and this document formed the foundation of the Modeled Savings offering. In 2009, New Buildings launched an enhancement to the Whole Building offering called the Path to Net Zero (PTNZ) Pilot that delivered increased incentives for more robust early design assistance (which advanced the conversation around EUI by requiring a shoebox model at the charrette), as well as enhanced technical assistance beyond energy modeling (such as daylighting studies and computational fluid dynamics (CFD) analysis), whole-building monitoring, and advanced metering. The baseline for PTNZ Pilot projects was 60% energy savings beyond Oregon code, and while solar installations played heavily into achieving the goals of PTNZ, 50% of the savings beyond Oregon code was achieved through energy efficiency alone.

Table 1. Modeled Savings and PTNZ Pilot incentives in 2009.

Design Phase	Modeled Savings Incentives	Path to Net Zero Pilot Incentives
Early Design	$2,500 for design charrette	$10,000 for integrated design charrette
Design	Up to $25,000 for energy modeling	Up to $50,000 for energy modeling and energy-related technical studies
Construction	$0.10/kWh and $0.80/therm (up to $499,999); commissioning required	$0.20/kWh and $1.60/therm (up to $499,999); commissioning required
Post-Occupancy	N/A	$5,000 for whole-building monitoring and additional $0.20/ft^2 for subsystem monitoring (up to $30,000)

Eight projects completed the PTNZ Pilot and provided many lessons through reviews of the projects' results, third-party evaluation comments, and customer interviews. This led to improvements that were incorporated into the re-launch of PTNZ as a regular offering in 2014. As the PTNZ offering provided higher incentive amounts, it also required acceptance in advance by New Buildings engineers. This re-launched offering was well-received by the design community, and many architecture and consulting firms adopted this approach as a new foundation for their design strategies and client engagement.

Evolution of Energy Code & OPUC Policy Change

The Oregon Building Codes Division has released many updates to the OEESC since 2004 and each update requires analysis of energy measures for all the offerings. Often this deep dive into the offerings at code updates results in measure loss for the prescriptive offerings, as equipment becomes code-minimum and no longer eligible for incentives. By ushering more projects into the Whole Building and PTNZ offerings, the Program increases customer engagement, as well as its ability to claim savings.

New Buildings uses the Oregon Energy Efficiency Specialty Code (OEESC) to set the baseline determining the potential energy savings. In 2019, the OEESC had a momentous update to align with ASHRAE 90.1 2016, and the OEESC update cycle would now follow ASHRAE

90.1. In 2019 and 2021, more updates occurred to align with ASHRAE 90.1 2016 and 2019, with another update expected in 2024 that would align with ASHRAE 90.1 2022.

ASHRAE 90.1 Appendix G

ANSI/ASHRAE/IES Standard 90.1 (referred to herein as 90.1 or the Standard) is the basis for most non-residential energy codes in the United States and undergoes continuous maintenance with new versions published on a three-year cycle. The 2013 and prior editions offered two compliance paths: a prescriptive path and a performance path (known as the Energy Cost Budget, or ECB, method). The 2016 edition introduced a third compliance option: the Performance Rating Method (PRM - also known as Appendix G, per that section of the Standard). Prior to the 2016 edition, Appendix G had been used to rate the performance of buildings for beyond code programs, such as the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Rating System and ASHRAE's Green Building Standard 189.1.

With the 2016 edition of 90.1, modelers could use the same building models for both beyond-code programs and for code compliance. A second change was introduced with the 2016 edition where the baseline scenario is fixed at a level of performance approximately equivalent to the 2004 edition. This was a radical change to how a baseline is conceptualized for those hoping to quantify energy savings above code. Historically, with a whole building modeled approach the energy savings would be determined as the difference in consumption between a baseline model scenario and a proposed model scenario. Under this change, the baseline scenario would be more abstract, defined as some deration of the fixed 2004 edition baseline model, as represented in Figure 1. From a code development perspective, this change was made so that rather than updating the stringency of the Standard with each subsequent edition, compliance with new editions would require a reduced deration factor in the form of a reduced performance cost index (PCI). To demonstrate compliance, the proposed building design needs to achieve a performance cost index less than targets based on building type and climate zone.

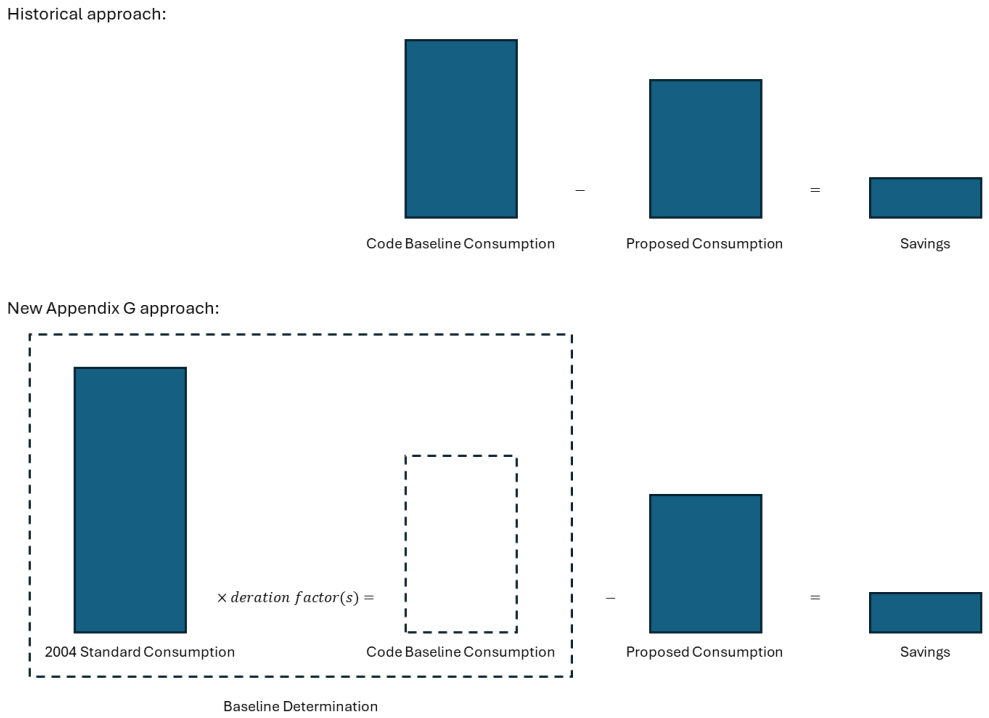

Figure 1. Simple representation of historical baseline approach vs. new Appendix G approach

With adoption of 90.1 as the Oregon energy code, which allows PRM as a compliance option, New Buildings had an opportunity to align an offering around the PRM. Such an offering could benefit the market in promoting familiarity with and usage of the PRM pathway for code compliance. Program benefits included a reduction in development costs – rather than creating separate modeling guidelines and baseline system mappings the Program could leverage the rulesets in 90.1. For participants, there was potential for less modeling burden, as the same models could be used for multiple purposes: demonstrating code compliance, participating in the Program, and participating in other beyond code programs also designed to accept Appendix G models, such as LEED. The hope was that modelers would no longer need to create separate energy models specific to New Buildings' requirements, thereby reducing burden on applicants and increasing participation. With the Appendix G baseline requirements largely static across future version, there was also potential for energy modeling software companies to include features to automate the baseline scenario generation, further reducing both the amount of time required to create the models and the amount of review time for program staff, with assurance that baseline requirements were being followed per the software automation.

Creating an offering around Appendix G also posed immediate challenges, first and foremost being difficulty in determining baseline scenario equipment costs. The baseline scenarios are well defined by Appendix G but to a 2004 edition of the Standard; once derated through the compliance test, the baseline becomes an abstraction that is challenging to cost. This posed a problem for New Buildings, which at the time was required to demonstrate cost effectiveness via a test of measure-level incremental costs compared to avoided costs. The incremental costs could no longer be determined without the ability to determine baseline scenario costs. This challenge was brought to the OPUC and an exception was granted to give Energy Trust time to study and test ways to design an offering incorporating Appendix G that still allows for measure-level testing of savings and costs. Attempts were made to demonstrate

cost effectiveness of measure packages using prototype building models and cost estimates from a third-party cost consultant, but ultimately results were too variable to allow use of this approach. In November of 2023, the OPUC adopted commission staff's recommendation allowing Energy Trust to use the Utility Cost Test (UCT) for a whole building approach in the New Buildings program (per Docket UM 1696). This change was key to enabling New Buildings to develop a whole building offering designed around Appendix G without requiring testing for measure-level cost effectiveness. Instead, New Buildings is able to align the whole building offering with the PRM per Appendix G and limit the need to understand incremental cost at the measure level.

Another large challenge to creating an offering around Appendix G was determining the energy savings by fuel type for a proposed design against an Appendix G baseline. The compliance test used by 90.1 is based on energy cost output from the models, not energy consumption. Appendix G also dictates the fuel type of the baseline, regardless of the fuel mix of the proposed design. Since all Energy Trust programs operate under a fuel neutrality policy, this required attention in adapting the Appendix G approach to determine energy savings. Furthermore, energy reductions at the end-use level have not been even across all end-uses from the 2004 edition – for example, service hot water minimum efficiency requirements have changed very little across the 90.1 cycles, while space heating and cooling efficiency requirements have changed dramatically.

To address these issues, New Buildings explored an approach to determine site energy savings against an Appendix G baseline. At the time (2019), few jurisdictions nationwide had yet adopted or were planning to adopt 90.1-2016 as the basis for their energy code, and no other incentive programs were identified as having designed an offering around 90.1-2016 Appendix G. Valuable feedback and information was received from industry partners, such as the Northwest Energy Efficiency Alliance (NEEA), but no fully-fledged approach appeared to exist at the time. It seemed that this was new territory and New Buildings decided to spearhead a unique approach for defining an energy savings baseline from the 90.1-2016 Appendix G baseline scenario and created an associated tool. Conversations with NEEA provided suggestions as to an approach that focused on end-use adjustments, and the New Buildings program explored this idea, eventually incorporating it into a tool.

Energy Modeling Summary Workbook

New Buildings savings are determined from the submitted Appendix G baseline model (representative of a 2004 edition of 90.1) and proposed design model via a tool called the Energy Modeling Summary Workbook (EMSW). The energy modeler inputs the modeled consumption output into the EMSW along with building type and location (ZIP Code, which the tool uses to determine ASHRAE Climate Zone), and the EMSW outputs energy savings and associated incentive total. There are two main steps in the overall process:

1. The whole building energy use for the reference year (ex. 2016, 2019, etc.) is derived from the Appendix G baseline model results using end-use energy ratios (described below).
2. A Program Baseline is determined from the whole building kWh and therm consumption values found in step 1 by adjusting the end-use fuel ratio to represent a fuel mix consistent with the proposed building. This is done so that fuel switching is not incentivized.

As alluded to earlier, the Building Performance Factors (BPF) used in the compliance test of 90.1 are based on energy cost output and could not be used to determine a Program Baseline as described above. However, the process used by 90.1 for developing the BPF was leveraged to determine end-use energy ratios. The BPF determination is explained in PNNL-25202 and shown in Figure 2. The prototype model output used to derive the factors is publicly available, and end-use energy consumption is provided in addition to energy cost. New Buildings calculated end-use energy ratios in a manner consistent with determination of the BPF, except that end-use site energy consumption was used in place of energy cost (also shown in Figure 2). The end-use energy ratio calculations maintained the same building type groupings used for the BPF determinations (e.g., Office end-use ratios are an average of the Small Office, Medium Office, and Large Office end-use ratios). New Buildings calculated end-use energy ratios for all building type groupings, but only for the locations coinciding with Energy Trust service area (ASHRAE Climate Zones 4C and 5B); the results for 90.1-2019 Climate Zone 4C are shown in Table 2.

BPF Determination:

$$BPF_{Year\ X} = (\sum \frac{Prototype\ Building\ Regulated\ Energy\ Cost_{Year\ X}}{Prototype\ Building\ Regulated\ Energy\ Cost_{2004}})/N_p$$

End-Use Energy Ratio (EUER) Determination:

$$EUER_{Year\ X} = (\sum \frac{Prototype\ Building\ Regulated\ End\ Use\ Energy\ Consumption_{Year\ X}}{Prototype\ Building\ Regulated\ End\ Use\ Energy\ Consumption_{2004}}) /N_p$$

where:

$Prototype\ Building\ Regulated\ Energy\ Cost_{Year\ X} =$ *The portion of annual energy cost due to regulated energy use from a given PNNL prototype building, climate zone, and edition of Standard 90.1*

$Prototype\ Building\ Regulated\ Energy\ Cost_{2004} =$ *The portion of annual energy cost due to regulated energy use from a given PNNL prototype building, climate zone, and the 2004 edition of Standard 90.1*

$N_p =$ *Number of prototype buildings of a particular building type (example, for Office building type Np is three: Small Office, Medium Office, and Large Office)*

Figure 2. BPF Determination and End-Use Energy Ratio Determination.

Table 2. End-Use Energy Ratios for ASHRAE 90.1-2019, Climate Zone 4C.

End Use	End Use Ratios								
	Multi-family	Health-care/ hospital	Hotel/ motel	Office	Restau-rant	Retail	School	Ware-house	All others
Space Heating (Regulated)	0.21	0.28	0.17	0.39	0.53	0.61	0.54	0.65	0.42
Cooling (Regulated)	1.21	0.70	0.59	0.50	0.74	0.56	0.56	0.42	0.66
Ventilation (Regulated)	0.86	0.63	0.57	0.71	0.31	0.48	0.45	0.70	0.59
Water Heating (Regulated)	1.00	0.93	1.00	0.98	1.00	0.95	0.99	0.97	0.98
Lighting (Regulated)	0.61	0.70	0.37	0.44	0.31	0.57	0.25	0.36	0.45
Lighting (Unregulated)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pumps (Regulated)	0.81	0.53	0.63	0.81	1.00	1.00	0.44	1.00	0.78
Heat Rejection (Regulated)	0.70	0.58	1.00	0.81	1.00	1.00	1.00	1.00	0.89
Supplemental Heat Pump (Regulated)	0.21	0.28	0.17	0.39	0.53	0.61	0.54	0.65	0.42
Exterior Usage (Regulated)	0.45	0.42	0.53	0.27	0.32	0.35	0.31	0.46	0.39
Plug and Process Load (Unregulated)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Elevator/ Misc. Energy (Regulated)	0.89	0.90	0.78	0.85	1.00	1.00	0.43	1.00	0.86
Misc. Energy (Unregulated)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Refrigeration (Regulated)	1.00	0.76	0.80	1.00	0.51	1.00	0.56	1.00	0.83
Refrigeration (Unregulated)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The following elaborates on the two-step process previously described. All calculations are embedded in the EMSW. Based on building type and location (ASHRAE Climate Zone) the appropriate end-use energy ratio is applied to each end-use consumption of the Appendix G simulated output. Note that the ratios for unregulated uses are always 1.0. End uses are then summed to determine the regulated and unregulated components for kWh and therm consumption. To ensure fuel switching is not incentivized, the regulated results are adjusted to match the regulated fuel mix of the proposed design at the end-use level. This is accomplished by only adjusting the consumption of each of the following regulated end-uses to match the fuel mix of the proposed design for that end-use: Space Heating, Domestic Hot Water, and Cooling. These are end-uses where a fuel switch could occur from the Appendix G baseline ruleset. The results comprise the Program Baseline against which energy savings are determined by subtracting the proposed model energy consumption from the Program Baseline.

New Buildings has been tracking Program Baseline EUI against the Zero Code Energy Calculator, an external resource for predicting code-minimum EUI for 90.1-2016 and 90.1-2019.

The Zero Code Energy Calculator results are based on code-compliant prototypes modeled by the Pacific Northwest National Laboratory. Comparing the Program Baseline to these results can provide some assurance that the Program Baseline is a reasonable and appropriate representation of expected code-minimum performance. For building types that align neatly with the prototype selections, the results tend to agree favorably; see Figure 3 for comparison results for the three most common building types participating in the Whole Building offering – office, multifamily, and school.

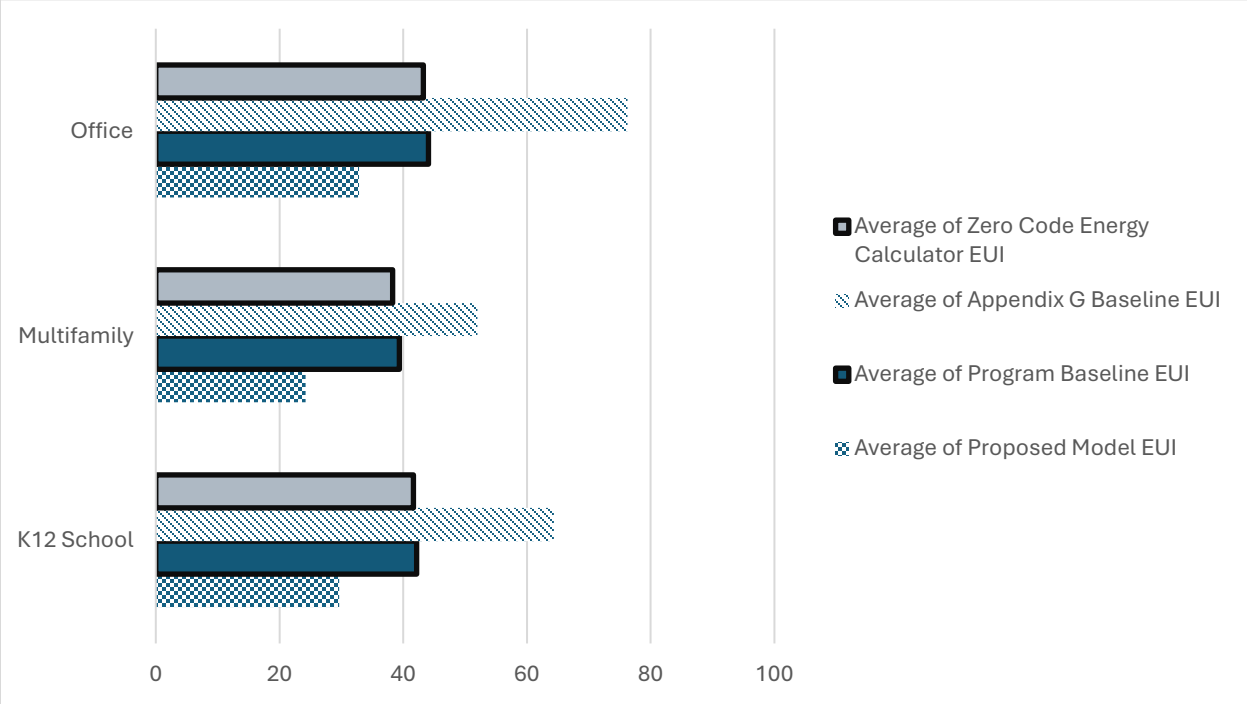

Figure 3. Program Baseline EUI compared to ZERO Code Calculator EUI

Holistic Approach to Building Design

Including Whole Building and PTNZ, New Buildings maintains a total of four incentive offerings which focus on a holistic building design approach. Market Solutions is designed for small-to-medium and large multifamily projects. It has become the gold standard for affordable and market-rate multifamily developments in Oregon. In addition, New Buildings saw a large increase in data center projects coming to Oregon and developed an offering for this unique and high-energy use building type. In 2023, these four offerings represented 87% of the kWh savings and 45% of the therm savings through New Buildings; however, they represented 22% of the total projects enrolled (the remaining 78% of projects enrolled through the system-based offerings).

Table 3. Incentives for Holistic Building Approaches in 2024.

Design Phase	Market Solutions for Multifamily	Data Centers	Modeled Savings	Path to Net Zero
Early Design	Up to $3,500 for design charrette	N/A	Up to $6,500 for design charrette	Up to $6,500 for design charrette
Design		N/A	60% of cost (up to $40,000) for modeling and energy-related technical studies; 50% of cost (up to $15,000) for design review commissioning	60% of cost (up to $40,000) for modeling and energy-related technical studies; 50% of cost (up to $15,000) for design review commissioning
Solar	90% of cost (up to $1,800) for solar feasibility study	90% of cost (up to $1,800) for solar feasibility study	90% of cost (up to $1,800) for solar feasibility study	90% of cost (up to $1,800) for solar feasibility study
Construction	$0.20/sq ft to $0.50/sq ft based on EUI savings	$0.20/kWh, up to $500,000	$0.20/kWh and $0.80/therm (up to $500,000); 50% of cost (up to $20,000) for advanced metering	$0.30/kWh and $1.20/therm (up to $500,000); 50% of cost (up to $20,000) for advanced metering
Post-Occupancy	N/A	N/A	N/A	$2,000 for net zero certification

Lessons Learned – Customer Engagement

Continue to engage customers

Participation in Whole Building and PTNZ offerings has created a common vocabulary for high-performance building design in Oregon, as well as a common set of strategies to achieve higher EUI targets. Design teams follow an order for designing these buildings:

1. Start with passive systems
2. Move to active systems
3. Add renewables

New Buildings sees efficiency improvements in all building end uses and that contributes to achieving high program savings goals, even with the code increases over the last four years.

Set high goals but have a back-up plan

While many projects achieve the efficiency level required by the PTNZ program, there are some that start down the path and don't achieve the necessary EUI levels. As a market transformation program, New Buildings sees value in teams having robust goals from project

initiation, and higher efficiency gains persist throughout the life of the project. Even if the actualized EUI is not at PTNZ levels, project teams are still able to tap into higher incentives for early design, technical assistance, and advanced metering, and receive the lower incentive levels for equipment installation. As of February 2024:

- 199 projects were the early stages of PTNZ.
- 81 were not able to achieve the higher EUI and moved into the Whole Building offering.
- 85 met the EUI targets for PTNZ.

Engage with teams early

Early engagement is critical: the key to market transformation is to engage the owner and design team as early as possible to provide the most influence on energy efficiency measures. For Whole Buildings and PTNZ projects, this includes enrolling the project as soon as the design team is on board and continuing program connection throughout the project. New Buildings outreach managers employed some new strategies to increase early engagement that include mandatory early design assistance participation: the EMSW is now a required deliverable for the early design assistance incentive, and the outreach manager and New Buildings engineers conduct a quick "modeling kick-off" meeting with the teams. In addition, Whole Building projects require additional documentation to close out the projects, and Program engineers became a required participant in the site visits to confirm the installation equipment at substantial completion.

Solar is important

Solar is an important strategy to achieving lower EUI targets for high-performance buildings. With the launch of the 2019 Whole Building and PTNZ offerings, New Buildings increased support for solar at all stages of project design:

- Schematic Design – an incentive of $500 is added to the Early Design Assistance offering if a solar trade ally attends the charrette. This allows for an expert to discuss the viability of solar as early as possible in the design timeline.
- Design Development – an incentive of 90% (up to $1,800) is available for projects completing a solar feasibility study.
- Construction Documents – if projects do not intend to install panels at the time of project completion, an incentive of 50% (up to $15,000) is available for most projects to incorporate the rooftop panel design, added structural components, and infrastructure for solar-ready. If projects do intend to install solar, they are not eligible for solar-ready, but instead move to an incentive for solar installation, which offsets the cost of the panels.

This structure for solar incentives has helped to ensure that solar is considered as early as possible in the building design and has increased participation in the solar program for new construction projects.

Lessons Learned – Technical Tools and Internal Processes

Revise technical tools

When the Whole Building and PTNZ offerings re-launched in 2019, New Buildings developed two tools: the EMSW and the Technical Studies Summary Worksheet (TSSW). The

EMSW captured all the information needed for the energy model and the TSSW allowed teams to share the information for other studies, such as a shoebox model, daylighting and CFD. While the EMSW and TSSW were the workhorses of the Whole Building offerings, New Buildings received feedback from the energy modeling community that having two forms was cumbersome. They would prefer to have only one document that contained this critical information.

With the launch of the 2021 code update, New Buildings created a new EMSW with multiple tabs that collected all the required information for the energy model, including EUI targets and baseline methodology, as well as a tab for model results. It also includes a Technical Assistance tab to input the expected costs and submission timing for the model, as well as sections for other studies, such as daylighting, CFD. New Buildings received positive feedback on this new, comprehensive version and participation in the Whole Building and PTNZ offerings increased by 140% from 2019 to 2024. In addition, as Appendix G is a recognized tool throughout the country, energy modelers from outside of Oregon had a better understanding of the program and the steps for participation.

Since development of the Whole Building offering, there have been advancements to determining energy savings from Appendix G models. The Department of Energy (DOE) has released a Compliance Form and a Compliance Form Companion Tool for Appendix G PRM projects. The Companion Tool features options to determine above-code savings from Appendix G in a number of metrics, including site energy savings, and the approach aligns with that implemented by New Buildings (PNNL-35248). The Whole Building offering has also been reviewed by a third party and received feedback that the energy savings determination approach appears sensible and sound.

Streamline internal processes

Whole Building and PTNZ projects require extra due diligence and New Buildings is constantly looking at ways to minimize the administrative time involved. To this end, New Buildings created the Whole Building Task Force (comprised of Program staff from outreach, operations, and engineering) to streamline internal processes, reduce review time, and improve forecasting and reporting. Each Whole Building project is divided into four stages:

Stage 1: Early design assistance and EMSW review for technical assistance forecasting
Stage 2: Receipt of energy model
Stage 3: Completion of review for energy model and forecasting update
Stage 4: Project completion

The Task Force holds a 15-minute meeting at each of these stages to review forms and documents, discuss any issues with the review, and update the tracking systems. These meetings have increased project processing efficiency and created a shared understanding of Whole Buildings projects among the entire New Buildings team.

Opportunities to address

Challenging Market Sectors

New Buildings guides energy modelers through the Whole Building and PTNZ offerings for over 20 market sectors. While government and education sectors retain the highest levels of participation, multifamily and healthcare projects are gaining momentum. This wide range of building types has created challenges with the EUI targets in the Zero Tool and Zero Code Energy Calculator, and occasionally requires the New Buildings engineers to work with the design teams and modelers to create custom targets. These custom targets also require special attention in the EMSW and throughout the life of the energy model.

Table 4. Whole Building and PTNZ Market Sectors.

Market Sector	Number of Projects	Square Footage
Arts, Entertainment and Recreation	5	30,069
Car Dealership/Showroom	1	30,321
College/University	26	92,404
Courthouse/Probation Office	4	115,428
Fire Station	2	12,300
Fleet Yard	1	14,715
General Manufacturing	2	9,525
Grocery	2	149,698
Gym/Athletic Club	3	38,187
Healthcare	6	64,856
Hospital	7	178,277
K-12 School	42	98,002
Library	2	48,500
Lodging/Hotel/Motel	6	254,949
Convention or Community Center	3	67,579
Multifamily	28	121,624
Office	40	118,030
Police	1	75,000
Pre-K/Daycare	1	6,726
Repair/Maintenance Shop	3	31,333
Retail	2	168,649
Transportation Infrastructure	1	133,056
Warehousing and Storage	2	48,332

The new approach of determining a Program baseline from the Appendix G baseline scenario seems to work well for building types that fit nicely into the predetermined building type groupings available in 90.1, such as multifamily, office, school, etc. Stated another way, the Program baseline determination is expected to align best with code-minimum performance when

the proposed design aligns with the assumptions inherent in the prototype models upon which the end-use energy ratios are based. Challenge is introduced for building types that do not fit neatly into the building type groupings, such as courthouses, fire stations, libraries, etc. – for such building types, either the closest available match is used or the "All others" option is selected. One way to improve this would be to create additional prototype models for such building types, though this would pose a high development cost. Another less costly (though less comprehensive) approach could be to use all of the available prototype building types rather than averaging across the predetermined building groupings (i.e., have separate end-use energy ratios for small office, medium office, and large office rather than averaging these to have ratios for just office). The program is exploring these and other ideas for possible future refinements.

Challenging Building Types

A few building types pose unique challenges to the Whole Building offering for differing reasons. From an implementation perspective, smaller buildings (less than 25,000 square-feet) pose a challenge to the offering in that modeling assistance review time is more expensive relative to the low savings potential. From a project team perspective, it can also be a large investment to develop energy models for smaller buildings. Existing buildings undergoing major renovations can have a difficult time achieving above-code-minimum thresholds, especially those where the existing envelope remains and is poorer than the Appendix G baseline scenario efficiency requirements. Projects can incur a penalty that can be difficult to overcome in the other end-uses. Meanwhile, historic buildings are exempt entirely from the efficiency requirements of 90.1 per section 4.2.1.3, and therefore cannot use the Appendix G process. Finally, the program has found that campus-style projects with district systems have required special attention. While Appendix G does have sections for how to treat systems using purchased heat and/or purchased chilled water, it hasn't always been clear as to how a campus-style project would demonstrate compliance via the PRM. The Program has been treating these projects as a single package, taking advantage of any efficiencies across all the campus buildings as if it were one single structure.

New Approach to Baseline Determination

The new method of determining the Program Baseline from the Appendix G scenario has posed challenges for participants and modelers used to the historical approach. With the historical approach, the baseline scenario was concrete and easier to visualize. With the new approach, the baseline is an abstraction that cannot be fully determined until the Appendix G baseline model is created. This can be a challenge to estimate savings early in the process, when the Program Baseline is not fully determined and is estimated based on tools with broad building types like the DOE prototype models or the Zero Code Energy Calculator. The Program is hopeful that with continued education and increased familiarity with the new approach participants and modelers will become more comfortable with the application of the end-use energy ratios and get a better feel for how to estimate savings early in the process.

Update for new OESSC 2024

In 2024, the new version of Oregon code is expected to be released, with 90.1-2022 as the basis. This version has several new components that will be updated in the EMSW, including

formula modifications and changes to the technical guidelines for energy models. The end-use energy factors used by the Program will be recomputed using the consumption output from the 90.1-2022 prototype models from DOE. The new Energy Credits section of 90.1-2022 will be accounted for in the prototype models, so no additional stringency will need to be applied on top of the end-use energy factors. Additionally, the factors will likely be more lenient for major renovation projects. 90.1-2022 allows for such projects to use BPF multiplied by 1.05 for the compliance test. The Program is considering taking a similar approach with the end-use energy factors, as existing buildings are usually more constrained as to which energy efficiency measures can be installed.

Leverage for new public policies

Oregon has a long history of environmental practices, from the first bottle bill in the 1970s to one of the most aggressive commercial energy codes in the 1980s. The Whole Building offering continues to align well with approaches that aim to accelerate energy efficiency while meeting local, state, and national targets. The 2023 Oregon Legislature passed several new bills that require state agencies to achieve higher levels of energy savings and implement new technologies. The Whole Building and PTNZ offerings complement this new direction and will become a key strategy as agencies develop rules and policies to support the updated statutes.

In addition, New Buildings is seeing more and more customers who are interested in designing buildings with a focus on reducing, not just energy, but also carbon emissions. New Buildings aims to support those projects through existing incentive offerings that save energy and support solar installations. Another complementary addition to the Whole Building and PTNZ offerings that supports energy and carbon reductions was the recent update to include an add-on incentive in early design for Grid-Interactive Efficient Buildings. To achieve this add-on incentive, design teams must follow an updated agenda template that includes a robust discussion around the technology and system requirements. As Whole Building and PTNZ projects already have the option for advanced metering, they are perfect candidates to advance this conversation, and early design is the time to ensure the project team is thinking about these strategies. This incentive is intended to be the first step; New Buildings plans to expand incentive opportunities for grid interactivity in the future through both Technical Assistance and Installation stages.

Conclusion

As New Buildings continues to transform the market for new construction and major renovations in Oregon, a holistic approach to building design will be more important than ever. By creating sophisticated technical tools to complement the code updates and continuing to innovate the Whole Building and PTNZ offerings, New Buildings is poised to help projects achieve higher energy savings. The EMSW will continue to be a tool to provide participants with an easy way to determine an energy savings baseline from the simulated output of their Appendix G models.

Over the past 15 years, the Whole Building and PTNZ offerings have created a well-respected framework for design teams seeking high-performance and net-zero buildings. However, New Buildings constantly keeps one eye on the horizon to ensure these offerings continue to transform the market. By incorporating new technologies into the incentive structure and developing technical tools, they will continue to bring innovation to the market. In order to

achieve net-zero buildings, design teams and owners must be challenged to find the next innovation, and these offerings will be ready to meet that challenge.

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