Seattle
Office of Sustainability
& Environment

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Seattle Large Office Building

Planning for Compliance with Performance Standards

Located in downtown Seattle, this large office building was built in the 1950s and includes a small retail and food service space on the first floor. Given its size and location, the property is subject to both the Washington Clean Building Performance Standard (WA CBPS) and the Seattle Building Emissions Performance Standard (BEPS). The included planning study was completed in 2024, prior to finalized rulemaking for BEPS, to help outline estimate costs, timing, and opportunities for the property—and other similar downtown buildings on district steam—to comply with these standards.

About

Location: Downtown Seattle

Size: 100,000–150,000 ft^2

Original Construction: 1950–1960

Current Energy Use Intensity (EUI): 45 kBtu/ft^2/year

Current Greenhouse Gas Intensity (GHGI): 1.95 kgCO_2e/ ft^2/year

Project Plan: Implement ongoing efficiency efforts and electrical upgrades to enable a steam to heat pump conversion at equipment end-of-life.

Outcomes:

Emissions:

- 95% annual emissions reduction
- Reduces GHGIT to ~0.10 kg CO_2e/ft^2/yr to meet the 2036-2040 BEPS target of 0.47 kg CO_2e/ft^2/yr

Energy:

- 27% annual energy savings
- Reduces EUI to ~33 kBtu/ft^2/yr to meet the 2026-2028 EUIt of 63 kBtu/ft^2/yr.

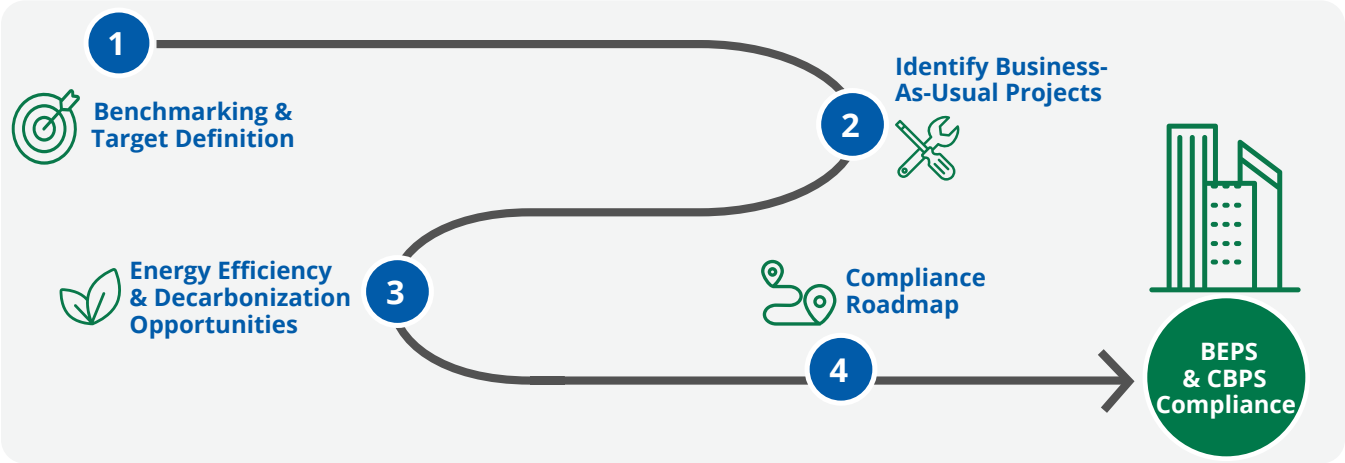
Estimated 10–14 Year Project Costs:

- Requires a $2m incremental cost investment ($16/$ft^2$) on top of a $8m business-as-usual cost for a $10m total project cost ($75/ft^2)

Existing Building Systems

The building has a curtain wall system of single pane, operable windows and insulated metal wall panels. Roofing is a built-up R-15 roof and lighting systems include a mix of linear fluorescent and LED. Heating and cooling is provided by a two-pipe system that utilizes 120°F heating hot water (HHW) and chilled water (CHW) that serve terminal units. HHW is provided by a district steam heat exchanger. CHW is provided by a water-cooled chiller (with approximately 8–10 years of remaining life) and a rooftop cooling tower. One main air handling unit serves each floor except for the top floor which is served by a dedicated unit. **A significant portion of building systems are original (1950s) and have reached or exceeded their useful life. Regardless of energy and emissions performance goals, upgrades to HVAC and plumbing risers and electrical systems are required for ongoing building operability.**

Steps to BEPS and CBPS Compliance Planning

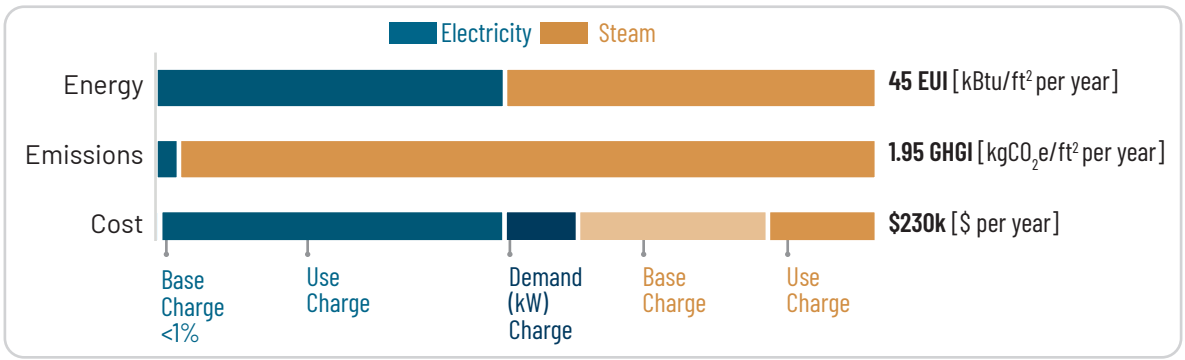


1 BENCHMARKING & TARGET DEFINITION

Existing Building Current Performance

The building currently performs at an energy use intensity (EUI) of 45 kBtu/ft²/year and a greenhouse gas intensity (GHGI) of 1.95 $kgCO_2e/ft^2$/year. While energy use between electricity and steam is approximately a 50/50 split, **the steam use accounts for more than 95% of the building carbon emissions.** Emissions factors use the provisional metrics for 2031–2035 BEPS targets with electricity at 0.0029 kg CO_2e/kBtu and district steam at 0.081 kg CO_2e/kBtu set in the ordinance[1].

Baseline Annual Metrics



1. Seattle Municipal Code Chapter 22.925 - BUILDING EMISSIONS PERFORMANCE STANDARD

Washington Clean Building Performance Standard (WA CBPS)

Is the Building Currently Tracking Towards Compliance? Yes.

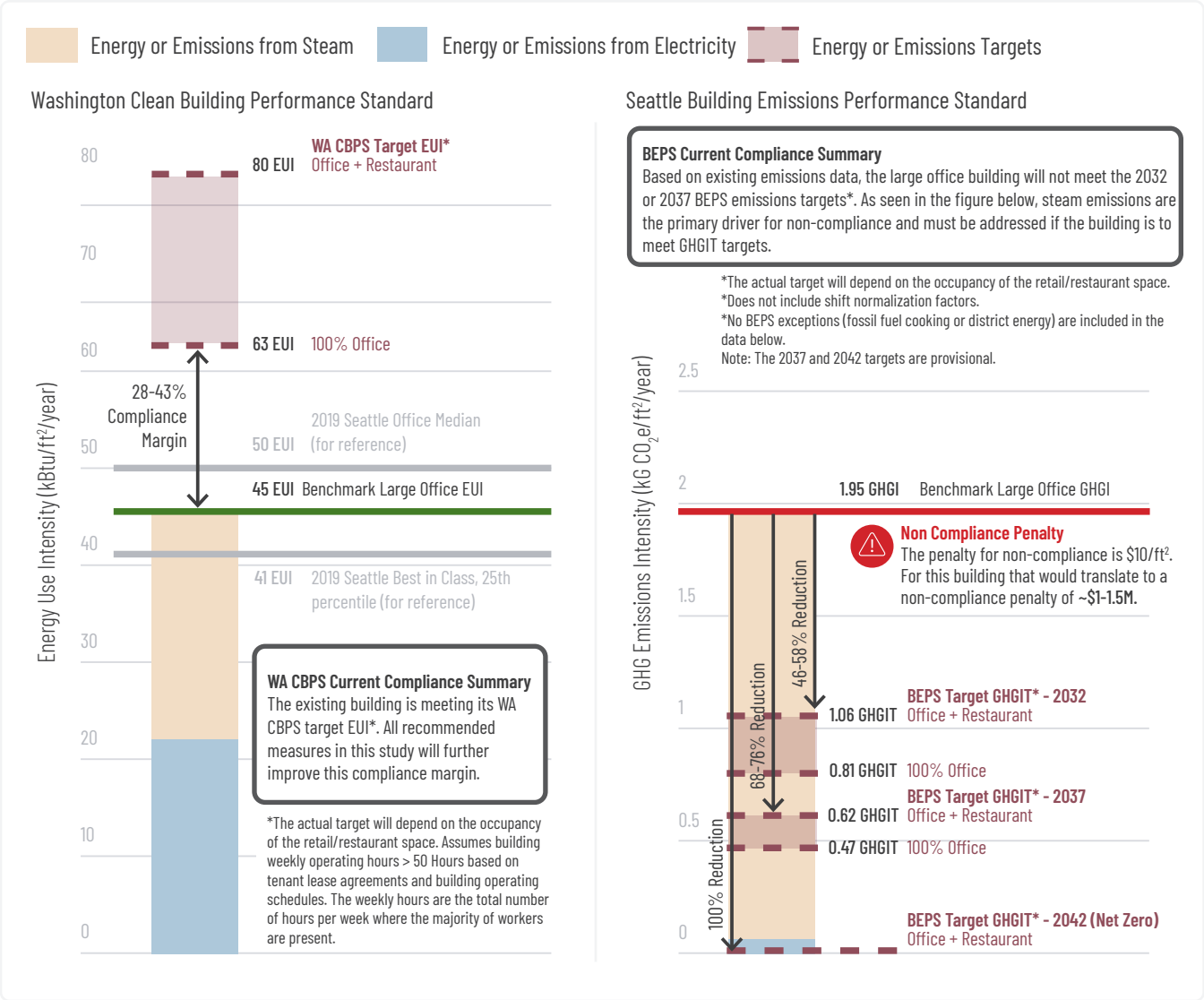
The WA CBPS compliance cycle is based on building type and size and this building requires compliance by June 1, 2027. The WA CBPS program is currently active, and rulemaking has already been established. The building is currently performing 28–43% better than its 2027 CBPS target of 63–80 kBtu/ft²/year (the range is due to whether the first-floor retail space is occupied as a restaurant or other occupancy type).

Seattle Building Emission Performance Standard (BEPS):

Is the Building Currently Tracking Towards Compliance? No.

The BEPS law is undergoing rulemaking, public engagement, and program development. This building will need to meet initial benchmarking verification and reporting by October 1, 2027 and first emissions target by October 1, 2032. The building is served by district energy (CenTrio Steam) and therefore can use the one-time district energy emissions deduction to meet compliance in 2031–2035. Based on existing emissions data, the building will not meet the its next BEPS emissions target of 0.47 $kgCO_2e/ft^2$/year in 2037. Since steam emissions are the primary driver for non-compliance, they must be addressed to meet the GHGIT target.

CBPS & BEPS Compliance Summary



2 BUSINESS-AS-USUAL PROJECTS

At equipment end-of-life, business-as-usual capital expenditures are required to replace systems with minimum code-compliant options. These are required investments, regardless of building performance standards, necessary to maintain minimum building functionality and operability. For this 1950s building, this includes:

- **Riser Upgrades:** Heating hot water, chilled water and plumbing risers are original to the building and in need of replacement.
- **Airside System Upgrades:** The top floor air handling unit (AHU) is near end-of-life.
- **Electrical System Upgrades:** Electrical infrastructure is original to the building and is near end-of-life. Replacement of the electrical system will be necessary to keep the building operational.
- **Water Cooled Chiller and Cooling Tower Replacement**: The cooling system (water cooled chiller and cooling tower) will be at end-of-life within the next ten years.

3 ENERGY EFFICIENCY & DECARBONIZATION OPPORTUNITIES

The building owner has already prioritized ongoing energy efficiency projects such as installation of more LED lighting, daylighting controls, building automation controls, and efficient terminal units as tenant spaces turnover and common areas are refurbished. Success of ongoing energy efficiency programs is evident in the energy use intensity performance of the building, well under its WA CBPS target. While window replacement was evaluated, a full curtain wall upgrade was found to be too costly for the load reduction and energy efficiency gains. Window film replacement is ongoing and will net minor performance gains.

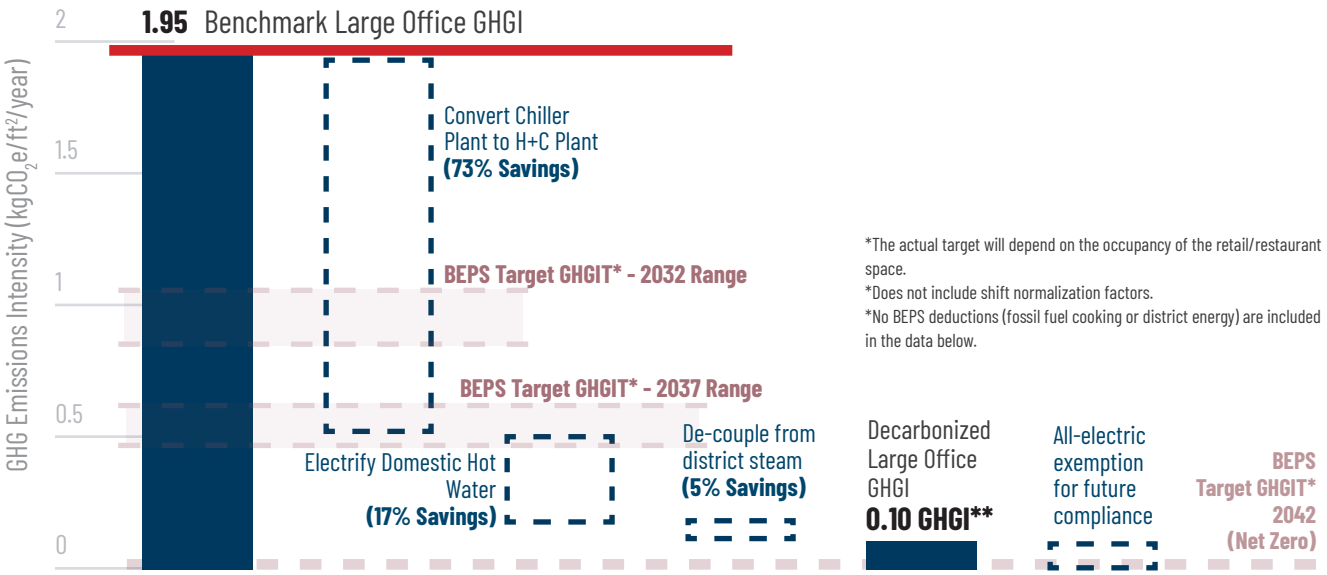
Because benchmarking revealed steam use as the primary driver of emissions, decarbonization opportunities focused on reducing steam. Options investigated ranged from piecemeal efforts such as one-off air-source heat pump rooftop units to replacement of individual steam coils with electric resistance coils, but these solutions did not provide enough emissions savings to meet the 2037 BEPS GHGI target. The recommended solution is to wait until the existing water-cooled chiller plant reaches end of life and then to replace it with an air-source heat pump plant that provides both heating and cooling. In addition, a domestic hot water (DHW) heat exchanger and electric boiler will be provided to serve DHW loads. These two measures will enable compliance with the 2037 emissions target. If full decoupling from district steam is desired, installation of electric boiler backup heat is also required.

"Metering" Steam Use:

Access to hourly or daily building heating load data can provide significant value to design teams. A challenge for existing buildings is the lack of submetering for heating systems. This building had no access to hourly steam data, thus to verify peak heating loads, equipment sizing, and energy savings potential, temporary “metering” was installed.

A camera was set up to photograph the digital steam meter readout over a period of four weeks coinciding with cold winter outdoor air temperatures and a monthly steam billing cycle. These data points were then used to build a relationship between the outside air temperature and steam usage which helped to right-size new heating equipment and validate projected energy and emissions savings calculations.

Greenhouse Gas Reduction Opportunity at a Large Seattle Office Building



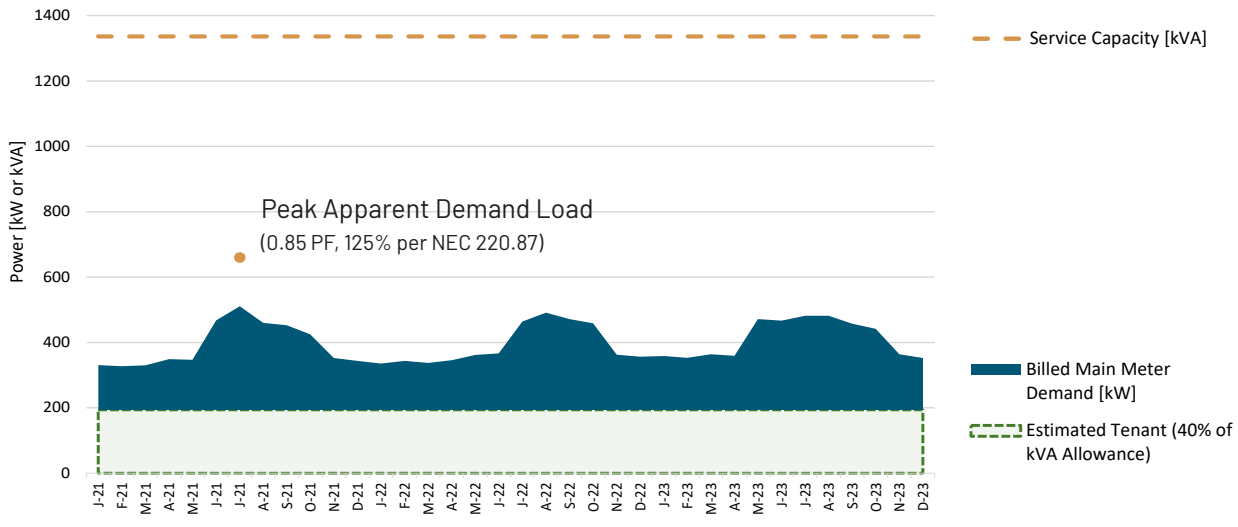
*The actual target will depend on the occupancy of the retail/restaurant space.
*Does not include shift normalization factors.
*No BEPS deductions (fossil fuel cooking or district energy) are included in the data below.

**These remaining emissions are from electric sources only based on estimated future electric emissions factors.

Building Electrical Capacity:

The building's electrical distribution equipment is original 1950s vintage with a 1600 Amp service. The decarbonization measures that enable BEPS compliance would require running new electrical feeds within the building but do not require a main service capacity increase beyond the existing 1600 Amp service. A service upgrade to power back-up electric boilers would be required if the district steam service is removed. That said, given the business-as-usual investment required to replace nearly all electrical gear and switchboards, the incremental cost of a service upgrade from 1600 Amp to 3000 Amp, in tandem with that project could be minimal relative to the total project electrical costs. Note: this analysis did not evaluate utility-side impacts as a result of a building electric service upgrade, which could result in additional cost.

Building Electrical Load Profile



4 COMPLIANCE ROADMAP

With the building already tracking to meet the 2027 WA CBPS EUI target, the compliance roadmap focuses on timing decarbonization projects to support future BEPS compliance. The roadmap utilizes the BEPS district energy deduction to meet the 2032 targets, with the major equipment upgrades occurring between 2032 and 2035 to enable BEPS compliance by 2037.

Business-As-Usual "Get Ready" Projects

Between 2024 and 2032, the priority is on budgeting for and implementing the business-as-usual "Get Ready" projects. These projects extend the building's operational life with replacement of original 1959 riser and electrical systems with systems that prepare the building for future decarbonization.

1. **Riser Upgrades**: Instead of providing like-for-like heating water, chilled water, and plumbing risers, provide risers designed for the future air-source heat pump heating and cooling plant.
2. **Airside System Upgrades**: Replace the top floor AHU with a unit that includes hydronic coils that are sized for the future heat pump. The main building AHU includes steam preheat coils. If replacing this unit before the plant upgrade, include hydronic coils.
3. **Electrical System Upgrades**: Upgrade the system to extend the life of the building while also preparing for future electrified load.

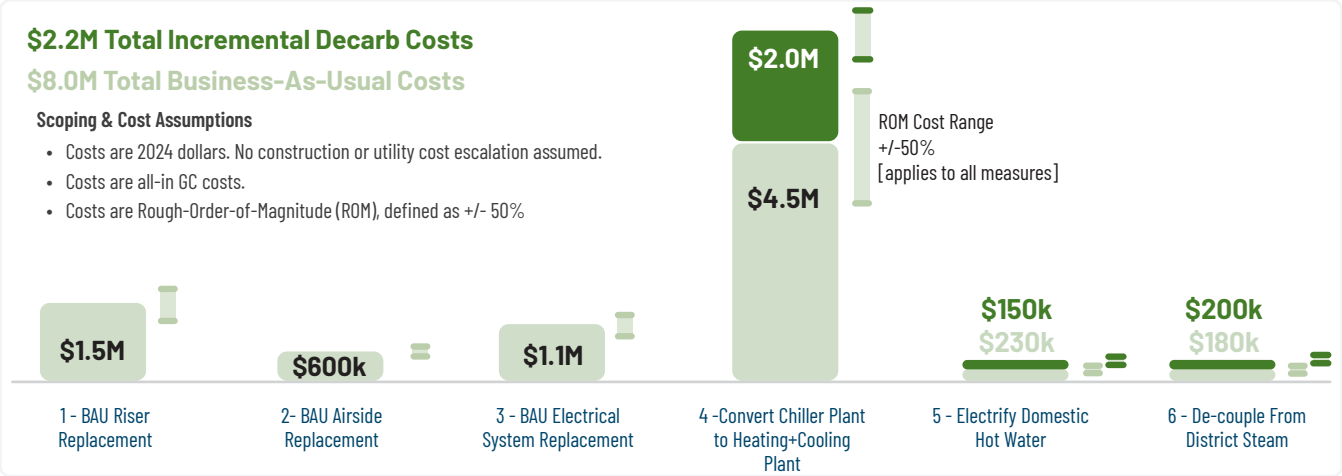
Decarbonization Projects

With the completion of the business-as-usual projects, the building is ready for the decarbonized equipment upgrades that must be completed by mid-2036 to meet the 2037 compliance deadline. These upgrade includes:

4. **Convert Chiller Plant to a Heating + Cooling Air-Source Heat Pump Plant**: At the end of the chiller's useful life, convert the water-cooled chiller plant to an air-to-water heat pump plant that can provide both heating and cooling.
5. **Electrify the Domestic Hot Water:** The heating hot water heat exchanger (HHW HX) will provide efficient first stage of heating during the winter months. An electric boiler will provide secondary heating during the winter and primary heating during the summer.
6. **De-couple from District Steam:** To meet the future the net-zero target by 2042, provide electric backup boilers to fully de-couple the building from district steam. Electric boilers would provide backup heat for the coldest days of the year.

Implementation of the decarbonization roadmap occurs over the next 10–14 years, has an estimated incremental cost of $2 to 3 million dollars over business-as-usual, results in a 95% carbon reduction, a 27% energy reduction, a 10% utility cost reduction (blended rate), and a marginal carbon abatement cost of $200–500/MT (assuming a 20 to 25-year system life cycle).

Compliance Roadmap Total Estimated Cost Summary



Next Steps

The next step for this large Seattle office building is to refine "business-as-usual" budgets to accommodate necessary near-term riser and electrical system upgrades over the next six to eight years. More detailed planning for the decarbonization effort should pause and be revisited in the early 2030's to consider technology advances and cost changes for hydronic heat pump and back-up systems.

Key Takeaways for Building Owners

A planning exercise is critical. This process should identify and quantify business-as-usual infrastructure upgrades and align those investments to support long-term energy efficiency and decarbonization requirements.

Understanding the requirements of CBPS and BEPS is essential to developing a successful life-cycle program with proactive maintenance, optimized staffing and actionable data. This process includes understanding your building's current and future targets, compliance schedule, and any exceptions or deductions that are applicable to the building. For this building, the district energy deduction allows a longer project implementation timeline where equipment can be replaced at end- of-life rather than early retirement. It will also be important to monitor how future program updates may impact your plan, such as future compliance targets, updated emission factors, and timelines for end-use deductions that may expire.

Due to the age of the existing building systems, this building has high business-as-usual costs. These costs may be lower in newer buildings. In even older buildings, more deferred maintenance investment may be required. A keen understanding of existing infrastructure and condition should always inform the "get ready" projects as well as the decarbonization projects.

This building is well equipped for heat pump heating because it already utilizes low temperature hot water (120°F). Future technology improvements for heat pump heating should be monitored, specifically around low temperature performance. This may reduce or eliminate the need for back-up electric boilers and could potentially reduce costs given these projects need not be completed until the early 2030s.

Why reduce building emissions?
In Seattle, buildings are one of the largest sources of climate pollution, responsible for more than a third of our city's greenhouse gas emissions. These emissions pollute our air, accelerate climate change, and harm people's health and the environment while disproportionately impacting communities of color and people with lower incomes. Seattle's new Building Emissions Performance Standard (BEPS) requirement is one of the most impactful climate actions Seattle is taking. For more information, email cleanbuildings@seattle.gov.