Sellen

ZGF
ZIMMER GUNSUL FRASCA ARCHITECTS LLP

Operable Windows at Confidential Client Office Headquarters Sellen, LEED Gold

8. Energy Performance Program

Our team is proposing a design with an Energy Use Index (EUI) of 30.1kBtu/sf/yr, with a proposed betterment that allows the facility to achieve an even lower EUI. We have used simple, straightforward systems that allow for tenant comfort and control.

1063 Energy Performance Goals

We are proposing a 30.1 kBtu/sf/yr energy savings commitment (please see the table below for our energy inputs and assumptions). Additionally, we believe that the 1063 Block Replacement occupants have the ability to drop this performance to an EUI lower than 30.1 kBtu/sf/yr if they choose to participate in the building's energy-saving components that we have incorporated into the design. These components include operable windows for passive cooling or turning off their systems when not at their desks. We further expand upon the tenants' expectations later in this section.

Betterment: Achieving 27.6 kBtu/sf/yr

We believe that we can drive the building's energy performance well below the 30.1 kBtu/sf/yr commitment by incorporating a roof-mounted photovoltaic (PV) system that meets 7% of the total building energy and enables the project to achieve a LEED Platinum Certification. We have included more information about this proposed betterment in Section 17.

Achieving our EUI Commitment

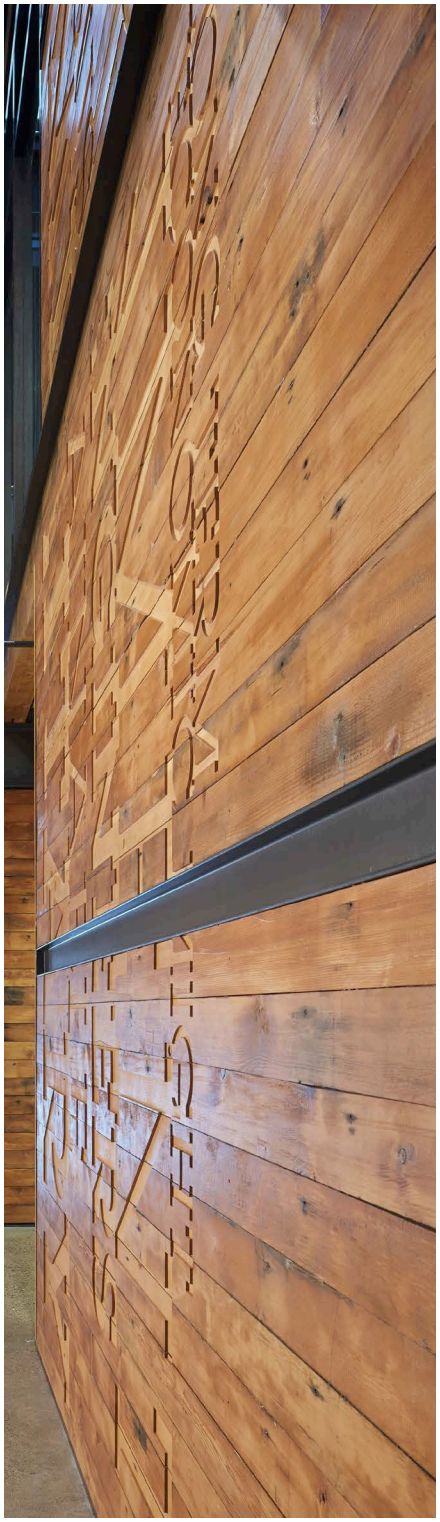
In the proprietary meetings, our design-build team's mechanical and high-performance designer, WSP Group, noted the industry statistic that a building is deemed successful when 80% of its occupants are satisfied with the facility's temperature and lighting controls. When our team set out to design the 1063 Block Replacement's HVAC and MEP systems to achieve your EUI, sustainability and comfort goals, we focused on answering two main questions:

1. **How do can we improve this statistic allowing more people to be satisfied all of the time?**
2. **How can we do this cost-effectively using minimal energy?**

Building Systems

The first portion of our solution centers around the building systems. Traditional building systems aim to keep the entire space at one temperature. **For your project, we are proposing a simple system that allows for a range of temperatures that is ultimately dictated by the occupants.** In the following chart, we have detailed the main elements of our building systems that allow us to accomplish this.

ENERGY INPUTS AND ASSUMPTIONS
Software: The energy modeling was done using Integrated Environmental Solutions Virtual Environment (IESVE) 2013
Occupancy: 800 FTE per Section 5 of the RFP
Zoning: Zoning per Section 4 of the RFP
Schedules of Operations: Weekdays, 6 a.m. to 6 p.m. except for 24/7 spaces. ASHRAE 90.1 -2007 load profiles for occupants, equipment and lighting.
Lighting: 0.7 W/sf
Plug Loads: 0.75W/sf
Thermostat Setpoints: 68 Winter, 76 Summer
24/7 Equipment (Server Room/IDF Room): 25kW x 8760hours = 219,000kWh/yr



Federal Center South,
Sellen | ZGF (Pursuing LEED Gold)

BUILDING SYSTEM FEATURES	OCCUPANT AND DES BENEFITS
1: Decoupling the ventilation air from the heating and cooling system.	
Provides 100% full fresh air to the occupants with no recirculation, which is typical of most VAV systems.	With no recirculation, there is less risk of spreading germs, improving occupant well-being.
Reduces duct work sizes and maximizes floor-to-ceiling height.	Maximizing ceiling heights allows more daylight in, enhances views, and better connects occupants to the outside.
Incorporates a simple, straightforward central air system, called Constant Air Volume.	This system is easy to control (off or on) and maintain, and it also provides lower first costs.
Reclaims energy from every unit of air leaving the building via an air-to-air heat recovery system.	Reclaiming energy allows our team to lower the building's energy use.
2: Relying on in-zone heating and cooling units that include occupant control, as well as passive cooling from operable windows. This system is not new or uncommon, but the ability for occupants to control heating and cooling energy is engaging and innovative. Other sophisticated systems, such as chilled beams, can achieve the same energy outcomes but are limited in their flexibility, occupant familiarity and have higher first costs.	
The system will be set to hit appropriate temperatures but can be turned off or on if occupants feel too hot or too cold.	Higher occupant comfort than traditional systems.
This system allows for occupant-enabled energy performance. The in-zone heating and cooling will be off during ideal times of the year, when windows can be used to maintain comfort.	Occupants always have the option to switch their system on if they prefer mechanical cooling and heating, but they are empowered to reduce HVAC energy use by using windows.
3: Sourcing heating and cooling as efficiently as possible.	
The mild climate in Olympia enables us to use both an air and water side economizer.	A water side economizer is up to five times more efficient than a new chiller. This is not available if we are tied to the campus central chilled water system.
A ground loop heat exchanger is expected to manage 60% of the heating, as well as 75% of the required heat rejection without using any water. This system only manages a portion of the heating cooling loads, because we have sized our system to balance first costs and energy performance.	The ground loop heat exchanger works at three to four times the efficiency of even the highest performing boilers, reducing energy usage. It also reduces the building's water use because traditional systems consume water at cooling towers.
The cooling system operates on a higher temperature of chilled water, around 55 degrees Fahrenheit. Typical systems operate at around 45 degrees Fahrenheit, as is the case with the campus chilled water loop.	This enables us to cool at higher efficiencies, and, if we decide to tie into the campus system, we can use the return water service, which would increase the efficiency of the campus plant. Thereby, we are reducing our energy use and providing an opportunity for additional strategies that not only work for our building but add value to the campus.
Leveraging heat recovery chillers helps us reduce the need for two separate pieces of equipment — a heating plant and a cooling plant — as the heat recovery chiller can do both and, under certain conditions, can do both simultaneously with remarkable efficiency.	This helps reduce first costs and mechanical plant space requirements while dramatically improving energy performance.
4: Asking occupants if they are comfortable and listening to them through a "3x3" measurement and verification process (described further in this section) that considers: 1) energy performance 2) water performance, and 3) indoor thermal comfort; with feedback loops to: 1) building operators, 2) tenant, and 3) the building owner.	
These feedback loops will consist of clear reporting, verbally at "all-office lunch-and-learns" and quarterly through written reports.	The goal is to empower all involved, allowing us to identify and execute the best solutions to any problems or improve on an already outstanding building.

Exterior Façade

This MEP and HVAC systems are enabled by a thoughtful building form and environmentally responsive façade that:

- **Manages Solar Loads:** This improves comfort and enables low energy use in the zone heating and cooling system, while also providing ample daylight and occupant views.
- **Has a Central Atrium:** This gives internally located occupants access to daylight and is also used as an exhaust path for our air system.
- **Is Ready for the Future:** We have set the building up for a plug-and-play photovoltaic (solar energy) system that would drop the building's energy use and its reliance on fossil fuel-based energy. The installation and use of photovoltaic panels is also an essential step to achieving LEED Platinum.
- **Shaped to Enhance Natural Ventilation:** In addition to being oriented for optimal views to the city and the Puget Sound, the fins are rotated to catch northern breezes that occur from early spring through late fall and shield the skin from southern breezes that occur during the winter months.

Commissioning Strategy

For building commissioning, our team recommends a collaborative approach. First, we will work with the DES to select your third-party commissioning agent (CxA) together. The CxA will work with the project team from design development onward, contributing design reviews and control sequence input. During construction the CxA would make periodic jobsite inspections and assist in developing the functional and

Case Study: Proven M&V Energy Results

Federal Center South has established energy performance nearly 40% better than ASHRAE 90.1, with an EUI of 25.7 kBTU/SF/year. During design, the proposed mechanical and electrical systems were completely new systems developed specifically for this office building. Our design energy model predicted it would achieve an estimated Energy Use Intensity (EUI) of 20.3 kBtu/SF/year (average of all existing office buildings in the Northwest is 106), significantly less than our contract goal of 27.6 kBtu/SF/year. The Sellen | ZGF design-build team led a four-phase process that drove the successful result.

Phase 1: Data Collection and Analysis
Once the building was operational, our team began to collect and organize systems data to identify the systems that were not providing clear feedback. We analyzed factors such as plug loads so we could better understand occupant behavior and combine our knowledge of how staff were using the facility with our systems data to form best practices.

Phase 2: Optimizing Controls
Using the data collected in Phase 1, our team improved building performance by looking into the HVAC and central plant operations to optimize the times in which systems turned on and off, as well as the levels in which these systems were operating.

Phase 3: Operation Handover and Seasonal Tuning
After optimizing controls, our team focused on educating GSA building operators on performance opportunities and limitations throughout the building, including insights into how staff were interacting with the building. Addressing the change of temperatures throughout the year, the team also continued to improve thermal comfort by adjusting air supply on especially cold or warm days.

Phase 4: Tracking and Refinement
In the final months of the M&V period, the team continued to track the building's performance, refine control sequencing and further streamline the building's integrated systems.

system test scripts. During equipment start-up, the CxA would witness the subcontractor start-up procedures and then participate in functional and system tests.

As a supplement to the third-party CxA, we plan to require our mechanical and electrical engineers and subcontractors to self-commission their systems all the way through Level 5 Integrated Testing. The engineers and subcontractors will develop their own test scripts for functional, system and integrated testing, as well as self-perform those tests. Any additional testing that the CxA wants would be incorporated into the test script.

Although this seems duplicative with the CxA's work, we have found that the project team that designed and built the system has the deepest understanding of how the systems should be performing. Most importantly, the project team now "owns" the operation. Sellen has had great results using this process at a two major mission-critical data centers, the Swedish Issaquah Campus and a large office campus for a confidential client.

Measurement and Verification

The Sellen | ZGF team is taking what is referred to as a "3x3 Approach" to measurement and verification (M&V) for the 1063 Block Replacement project. This approach well exceeds the IPMVP requirements.

The 3x3 M&V process will be used to track is:

1. Energy Performance
2. Water Performance
3. Indoor Thermal Comfort

With feedback provided to the:

1. Building Operator
2. Tenants
3. Building Owner, the DES

The following are primary components of our M&V process. Our team will:

- Establish a detailed M&V plan early in design. This plan will start with discussions with the DES and the stakeholders to be sure we are measuring what matters and that everyone clearly understands their responsibility in achieving the performance targets.
- Publish an integrated "metering diagram" as part of the plans, rather than the traditional practice of having meters shown sprinkled throughout the plans by various disciplines. This clearly communicates the overall metering strategy, ensuring that we don't have any gaps (e.g. elevator energy not metered) or crossover between the energy categories (e.g. heat trace wired to a lighting panel).
- Include in the controls scope a simple "energy dashboard," which shows demand, consumption and EUI for electricity, gas and water in real-time, today and trailing 24 hours / 7 days / 30 days / year. This gives operators and owners immediate and continuous feedback on whether they are achieving optimal energy results or need to improve their performance.
- We have proposed a betterment to provide a "green screen" kiosk in the main lobby, similar to the kiosk we developed at Federal Center South. The green screen can inform tenants and visitors about the sustainable features of the building, inform them about their current energy and water usage, and encourage positive change through friendly competitions — for example, between floors.
- After occupancy, our performance analyst will receive weekly data from the control system on energy usage, water consumption and zone temperatures. We will analyze the data, compare the results to the design and identify sub-optimal performance. The performance analyst will issue formal M&V reports monthly during the first year. After the first year, the performance modeler will issue a simplified report quarterly.
- The M&V reports will compare our energy model to the actual operation of the building to inform the owner on how the facility is operating and potentially lead to revised design criteria for improved performance and cost savings in future State buildings.
- Sellen will regularly gather the M&V Team to review results, address any tenant comfort issues, and optimize the system operation. At Federal Center South, the first four months saw

Added Value: Energy Metering on 1063 Block Replacement

In order to meter the individual tenant heating and cooling energy we will use a pressure-independent control valve. This will allow us to measure the chilled water and heating hot water that is going to each zone box. The zones for a particular tenant can be added up to capture the total heating and cooling energy used by that tenant. Further, each circuit of plug load and lighting load will be measured.

energy consumption reaching 25% more than the target and some persistent comfort issues. The M&V Team recognized this and was able to reduce energy consumption to lower than the target while simultaneously resolving all tenant comfort issues.

- To engage the occupants, we will also host annual brown bag "lunch and learns" to report on the building performance and work with tenants to develop competitions for reducing tenant energy usage.

Year 1 Building Operations Optimization

As with all new construction, the design-builder and owner are presented with the challenge of operating a building that has never been built before. While we both have vast experience with similar buildings and systems, this particular building shell — on this site with these energy systems — has never been done before. Just like a car prototype, it will take some time to get it running as smoothly as planned. The benefits of the design-build project delivery method and this project's five-year energy performance program is that we have an integrated plan to work out the bugs and get the building working at full optimization.

Based on previous projects, specifically the Federal Center South facility, the Sellen | ZGF design-build team has experienced great success in putting together a team to support the building for the first year. For the 1063 Block Replacement, the "Year 1 Team" will be led by Sellen and includes members from the WSP Group (energy modeling), the mechanical subcontractor, the electrical subcontractor and ATS (building automation controls). Sellen will bring in other design team members as required. Each member will have a different level of resources, as outlined below.

The Sellen | ZGF team recommends that the DES hires one building engineer from the mechanical subcontractor for the first year of occupancy. This building engineer will work as part of the commissioning team, learning the intimate details of the systems. After occupancy, this building engineer will assist the DES staff in handling any trouble calls and work continuously to optimize system performance. The building engineer will leverage the relationships built during the commissioning phase with the mechanical engineer and controls technicians. The building engineer will work closely with the M&V Team to optimize the mechanical and electrical systems.

Ideally, we recommend that the DES bring in its long-term building engineer during commissioning. This person will also participate in commissioning activities, video-taped training and first-year optimization. After the first year of operation, the DES' building engineer will be thoroughly trained and set up for success. During Years 2 through 5, we recommend our design-build team continue to stay involved on a periodic basis to provide support to the DES' building engineer and provide M&V reports.

During the first year, the building automation controls contractor, ATS, will support the Year 1 team on site and via a secure internet connection. The controls technician will be scheduled for one day per week for the two months, every other week for the next four months, and monthly for the last six months. These visits are helpful for trouble-shooting, fixing miscellaneous issues, tuning the system as the weather changes, optimizing energy performance, augmenting the graphics and training.

In between visits, the controls

The Sellen | ZGF team has experienced great success in putting together a team to support the building for the first year. We recently worked with the GSA performing M&V for Federal Center South. The facility has established energy performance nearly 40% better than ASHRAE 90.1, with an EUI of 25.7 kBTU/SF/year.

Added Value: User-Friendly Building Controls

SkySpark is an analytics software platform specifically designed for monitoring, analyzing and auditing HVAC system performance. For the 1063 Block Replacement, the SkySpark system has been included in our budget and will be used for aggregating and displaying the meter data. The system will pull together the data from thousands of meters, analyze it and display the data in ways that are meaningful to the building operators and design engineers. The SkySpark system will allow operators to optimize the HVAC system performance, benchmark that performance against our energy goals and identify problems before they become tenant issues.

technician will be available to support the on-site team via the secure internet access. The remote access will allow the technician to monitor the system performance frequently and provide timely support to the on-site team.

Warranty Scope & Duration

Warranties

As a start, we would include the traditional one-year warranty on all design-build elements. In addition, many elements come with standard extended product warranties, including:

- Curtainwall: 5 years
- Roofing: 15 years
- Sealants and paint: 10 years

Together with the DES, we will study the value of buying five-year warranties for critical building elements. Examples would include elevators, air handlers, chillers, boilers, pumps, electrical switchgear and generators.

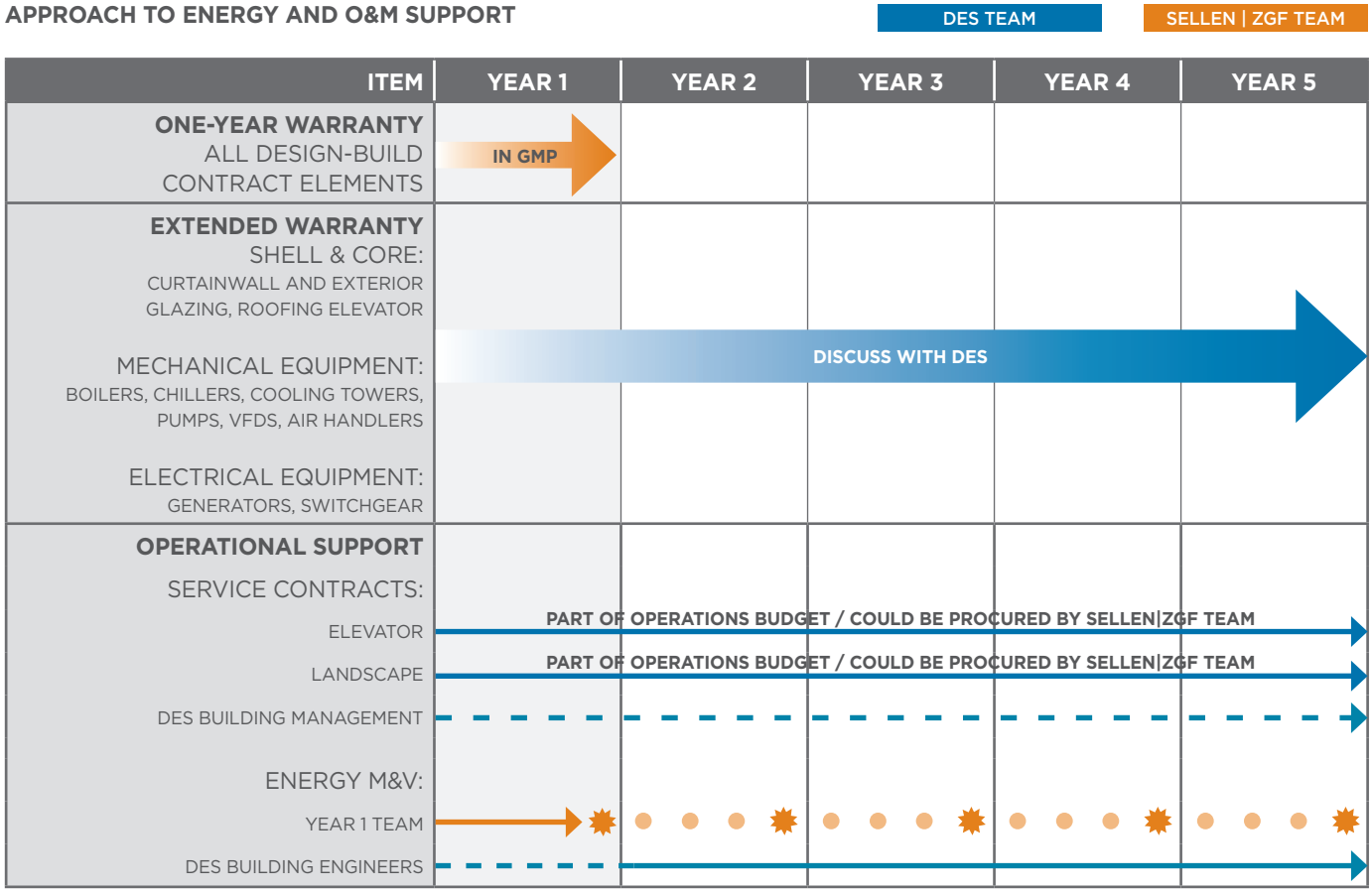
Along with extended warranties, we could solicit pricing for long-term maintenance agreements with select subcontractors as part of our procurement process. While the costs of the maintenance agreement would be paid direct from DES operating budgets, we can help you secure a lower price while the vendor is in a competitive stance.

Site and Landscaping

In the course of the GMP buy-out, our team would procure the site work and landscape contract and include a one-year warranty on plants and site furnishings. We would also help the DES procure a one-year maintenance contract from the same subcontractor to ensure that the plants thrive and that irrigation systems function as designed.

Throughout the first year, the landscape contractor will train the State's facilities staff on the maintenance program. As part of the 5-year energy performance guarantee, our team will continue to review the site landscape on a yearly basis to make sure water consumption

APPROACH TO ENERGY AND O&M SUPPORT



is meeting the performance requirements. We have included a series of site landscape betterments in Section 17 for additional staff training, improvements to the adjacent Olmsted Lawn and Capitol Way.

Owner Opportunities to Meet the Energy Goals

We anticipate owner obligations to meet the energy and maintenance goals will include the following:

- Maintain the installed equipment and materials in accordance with the manufacturer's requirements, Sellen's recommendations, and industry best practices.
- Operate the mechanical and electrical systems in accordance with the latest sequence of operations and Sellen's recommendations.
- Notify Sellen of any changes to control sequences, setpoints or operating schedules.
- Notify Sellen of any significant equipment or system failures.
- Allow Sellen full access to the BAS and lighting control systems, both on-site and via a secure internet connection.
- Prohibit tenants from having personal electric space heaters or refrigerators.

Tenant Opportunities to Meet the Energy Goals

As we have described in our building systems narrative, the tenants will be able to contribute significantly to the building performance, improving energy performance beyond the design goal. We would encourage the tenants to do the following to achieve our energy goals:

- Monitor and control their plug loads during the day.
- Turn off plug loads at the end of their day, including computers, monitors and task lights.
- Use passive cooling by opening windows when the system indicates it's appropriate.
- Within departments, brainstorm ideas to lower energy use.
- Participate in energy saving competitions.
- Take the stairs instead of using the elevator. Start off with taking the stairs down (reduces elevator trips by 50%) and then work on physical endurance to take the stairs up (the other 50%).
- For occupants without physical disabilities, to use the manual-opening doors rather than the ADA door openers. This will reduce heating and cooling losses.
- Check the "green kiosk" regularly week to review how they are performing. (Should you choose to incorporate this betterment.)

1063 Block Replacement: Designed for Ease of Maintenance

Our proposed systems and equipment provide a number of long-term maintenance advantages, including:

- Use of LED lighting throughout the building. LED lighting has an approximate lifespan of 18 years under normal office building operating conditions. This exceeds the typical interval between significant tenant space renovations when fixtures are typically replaced.
- A hydronic heating and cooling distribution system with components and equipment that are designed for reliability and long service life. As one example, we are including pressure independent flow control valves. These are serviceable in-line; have a life expectancy of at least 30 years; are self-balancing, reducing the cost of maintaining system performance in the years after installation; and improve hydronic system control, increasing the life expectancy of other equipment in the system.
- A ground loop heat exchanger. Typically, these can provide a no-maintenance, reliable source of heating for the life of the building.

Energy Model

Attached on the following pages, we have provided comprehensive energy models and narrative regarding the high-performance components of our proposed design.

The energy model for the 1063 Block Replacement can be found on page 114.

HIGH PERFORMANCE DESIGN NARRATIVE | EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Many HVAC professionals say a building is successful when 80% of the people are satisfied. Why can't we please more of the people more of the time?

What the HVAC professional is really saying is, that if you put 100 people in a space with set conditions – DB temperature of 72°F, no wind, minimal humidity, minimal direct sun, etc - that 80 of them will be satisfied. So how do we please more of the people more of the time? And how can we do this cost effectively in a manner that uses minimal energy?

What we are proposing is a simple system that, unlike traditional systems, which aim to keep the entire space at one temperature, allows for a range of temperatures that is ultimately dictated by the occupants.

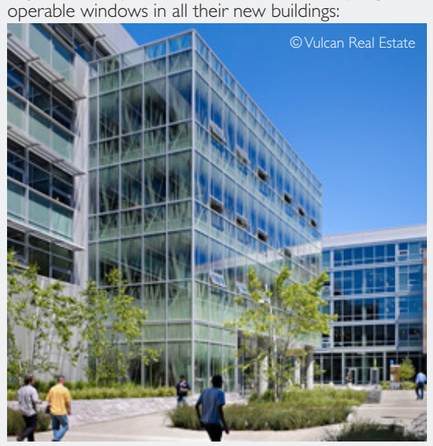
We do this by -
Step 1: Decoupling the ventilation air from the heating and cooling system. This allows us to

- provide 100% full fresh air to the occupants with no mixing at the main AHU like typical VAV systems, which means less risk of spreading germs and other nasties, improving occupant wellbeing
- reduce duct work sizes and maximize floor to ceiling height - allowing in daylight, enhancing views, and better connecting occupants to the outside
- incorporate a simple, straight forward central air system – Constant Air Volume – that is easy to control (off or on), maintain and has lower first costs
- Reclaim energy from every unit of air leaving our building, via an air to air heat recovery system

Step 2: Relying on in-zone heating and cooling units (that include occupant control) and passive cooling from operable windows. This provides:

- Comfort, year round. The system will be set to hit the appropriate temperatures but can be switched off by occupants if they are feeling too hot or too cold
- Occupant enabled energy performance. The in-zone heating + cooling will be off during ideal times of the year, when windows can be used to maintain comfort. The occupants always have the option to switch their system on if they prefer mechanical cooling/heating, but are empowered to reduce HVAC energy use by using their windows
- A common, well understood system, but the control that we are providing is innovative and the ability for occupants to control heating and cooling energy is engaging and thoughtful. More sophisticated systems, like chilled beams, can achieve the same outcomes but are limited in their flexibility, familiarity and have higher first costs.

High-tech companies, such as Amazon, are opting for operable windows in all their new buildings:



Step 3: Sourcing heating and cooling as efficiently as possible.

- The mild climate in Olympia enables both air and water side economizer. The latter, water side economizer, can be 5 times as efficient as a new chiller and is not available if we tied to the campus central chilled water system.
- A ground loop heat exchanger (GLHX) is expected to manage almost 70% of the annual heating load and does so at 3 to 4 times the efficiency of even the highest performing boilers. It is also expected to manage 75% of the required heat rejection without using any water which would be required in a traditional cooling tower based system (similar to the campus chilled water system). We do not attempt to manage all heating or cooling loads with our GLHX, as we have sized our system to balance first costs and energy performance.
- The cooling system operates on warmer chilled water (~55°F, typical systems operate at ~45°F as is the case with the campus chilled water loop). This enables us to cool at higher efficiencies. If we decide to tie into the campus system, we can use the return water service which would increase the efficiency of the campus plant. Thereby, we are reducing our energy use and providing an opportunity for additional strategies that not only work for our building but add value to the campus.
- Leveraging heat recovery chillers helps us reduce the need for two separate pieces of equipment – a heating plant and a cooling plant – as the heat recovery chiller can do both and, under certain conditions, can do both simultaneously with remarkable efficiency. This helps reduce first costs, and mechanical plant space requirements, while improving energy performance.

Step 4: Asking occupants if they are comfortable, and listening to them through a "3 x 3 Measurement and Verification" process that considers
i. occupant comfort,
ii. energy performance, and
iii. water performance

with feedback loops to
i. building operators,
ii. building owners, and
iii. building occupants.

These feedback loops will consist of straight forward reporting (verbally at "all office lunch and learns", quarterly in written reports, and in real time via a green kiosk). The goal is to take very complicated things and make them sound simple, to empower all involved allowing us to identify and execute the best solutions to any problems or improve on an already outstanding building.

ENERGY

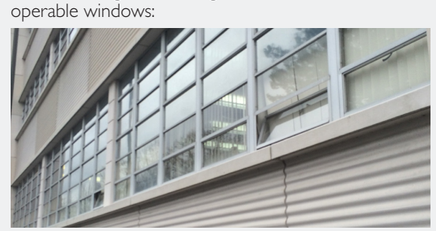
The building is modeled to achieve an EUI of 30.1kBtu/ft²/yr. This is equivalent to:

- A 38% reduction in energy cost against the ASHRAE 90.1-2007 baseline.
- 14 LEED EAc1 points.
- An energy cost performance of $128,000 each year; a $87,000 energy cost savings compared to a building built to the national standard.
- 810,000 lbs of CO_2 equivalent per year. This is almost 550,000 lbs less than a building built to the national standard.

INDOOR ENVIRONMENTAL QUALITY

The proposed building offers views from every orientation and ample controlled daylight, but the key to higher satisfaction is the engagement of the occupants in the comfort of their space. We have decided to maintain the access to operable windows that many of the GA building tenants are accustom to. We plan to update this strategy by integrating the windows with the HVAC system. Occupants can choose their comfort level by simply turn off or on their AC unit or opening a window. All office zones are equipped with 100% dedicated fresh air so if occupants decide they need their window closed, they can still breath easily.

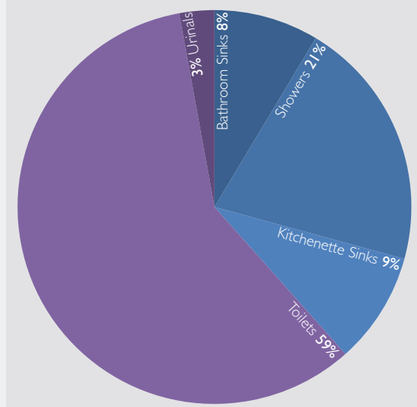
At the existing GA building, tenants are accustom to operable windows:



The proposed building incorporates the highest efficiency fixtures and is able to outperform a LEED baseline building by 35%.

DEVIATIONS FROM THE RFP

PROPOSED BUILDING WATER USE BREAKDOWN



1. Plug load study:
To confirm our assumption and better optimize energy performance, our proposal includes a plug load study of the existing GA building. This will help us identify the actual expected tenant loads, which may influence our energy strategies.

BETTERMENTS

1. Campus Chilled Water Connection:
A campus chilled water connection would eliminate the need for a supplemental chiller but would add the cost of constructing the connection to the district chilled water system. To fully assess the viability and cost effectiveness of this option we need more information about the cost of the chilled water energy. The information provided in Addendum 7 is insufficient for us to do a complete ELCCA of a connection. As the design progresses, we plan to discuss this option further with the chilled water loop operator and the State. We are carrying this option as a betterment for our proposal.

2. Thermal Storage:
Thermal Storage can help save energy and is most effective when larger 24/7 data room cooling loads exist as this heat can be captured and stored in the thermal storage, and then reused to heat the building. Currently, little is known about the 24/7 cooling requirements but the plug load study will help define these loads and better quantify the benefit of the thermal storage.

3. LOTT Ready:
Initially, the RFP required the building to be LOTT ready, which included plumbing the building's toilets and irrigation separately so that a LOTT connection could serve those end uses in the future. Subsequently, in Addendum 8, this LOTT ready requirement was removed. There still may be value in this solution and as such we are carrying it as a betterment.

4. Rainwater Collection:
Rainwater collection and reuse for irrigation and toilet flushing can cut the amount of water for toilet flushing in half, and help reduce the building's total water consumption by a third. The optimal tank size for a rainwater cistern is between 20,000 and 30,000 gallons. This tank can be dual purposed as a thermal storage tank in the summer, when rain is low, or if the LOTT system came online, and rainwater collection was no longer needed. To achieve the LEED WEc2 and WEc3 credits, a cistern of under 10,000 gallons can be used. However this strategy would not be sufficient, in itself, to allow us to achieve a LEED Platinum rating.

5. Renewable Energy:
The ideal renewable energy solution for this office building is solar electric photovoltaics (PVs). PV panels can be installed on the roof of the building to generate renewable electricity. It is estimated that for every 4,500 ft² of PV, the building's energy can be reduced by 1 kBtu/ft²/yr. Our PV betterment target is for PV's to meet 7% of building's energy consumption - 2.1 kBtu/ft²/yr. This results in a 136.5 kW system of almost 9,500 ft² and would drop our EUI to 28.0 kBtu/ft²/yr. This would also support a LEED Platinum certification for the building.

Another alternative would be solar thermal. Although more efficient than PVs, there isn't expected to be a significant hot water demand and as such, solar PVs are a preferred strategy over solar thermal.

HIGH PERFORMANCE DESIGN NARRATIVE | PROPOSED BUILDING PERFORMANCE

PROPOSED DESIGN BUILDING PERFORMANCE: 30.1 KBTU/FT²/YR

The building is modeled to achieve an EUI of 30.1 kBtu/ft²/yr. This is equivalent to:

- A 38% reduction in energy cost against the ASHRAE 90.1-2007 baseline.
- 14 LEED EAc1 points.
- An energy cost performance of $128,000 each year; an $87,000 energy cost savings compared to a building built to the national standard.
- 810,000 lbs of CO_2 equivalent per year. This is almost 550,000 lbs less than a building built to the national standard.

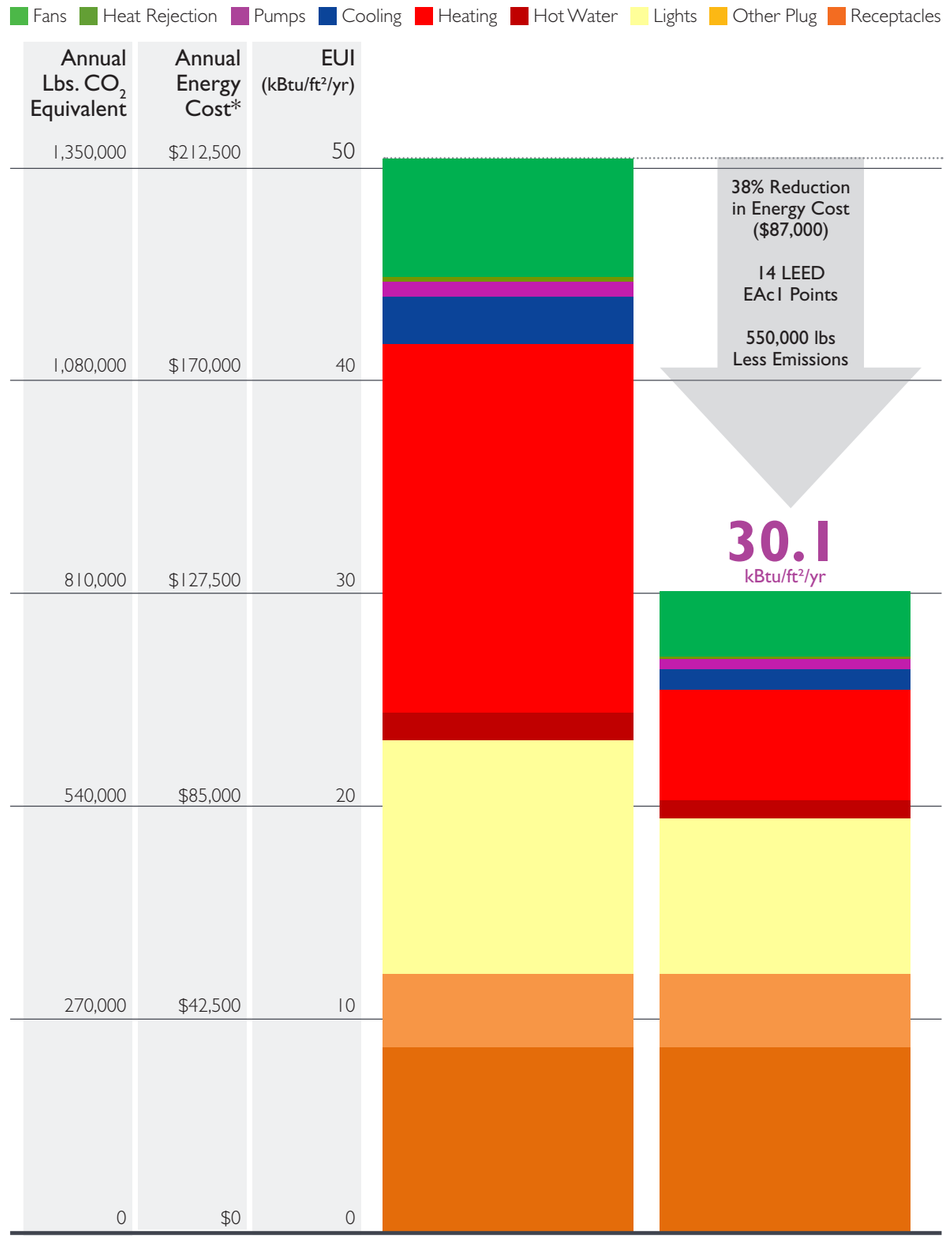
OCCUPANT ENABLED OPPORTUNITIES

The building is designed to engage the occupants to improve energy performance but the published performance does not require any special behavioral changes. If the occupants decide they don't want to open their windows on a nice day because of street traffic, they can leave them closed - 100% filtered fresh air will always be provided to their space so they can breath easy, and the modeled energy performance will still be achieved. As in any building, occupants can turn off lights or computers when they are not at their desk to save energy, but with our building, occupants can choose to turn off their AC system and use their windows. If we fully tenant the building with well educated, conscientious occupants who use their windows and turn off their AC systems when they are not at their desks, we can save an additional 0.5 to 1.0 kBtu/sf/yr, dropping the building's energy performance below the 30 kBtu/sf/yr mark.

ENERGY BETTERMENTS

1. **Solar Electricity:** PV panels can be installed on the roof of the building to generate renewable electricity. Our PV betterment target is for PV's to meet 7% of building's energy consumption - 2.1 kBtu/ft²/yr. This results in a 136.5 kW system of almost 9,500 ft² and would drop our EUI to 28.0 kBtu/ft²/yr. This would also support a LEED Platinum certification for the building.
2. **Solar Thermal:** A solar thermal system can be installed on the roof of the building to generate domestic hot water. Although more efficient than a PV system in terms of energy generated/area of system, the domestic hot water demand is estimated to be at most 2% of the building's energy demand. To meet half of the domestic hot water demand and offset 1% of the total building's energy, we can install a 1,800 ft² system, 104 kW solar thermal system. The system would also require a 300 gallon storage tank.

BLOCK 1063 REPLACEMENT: MODELED ENERGY PERFORMANCE

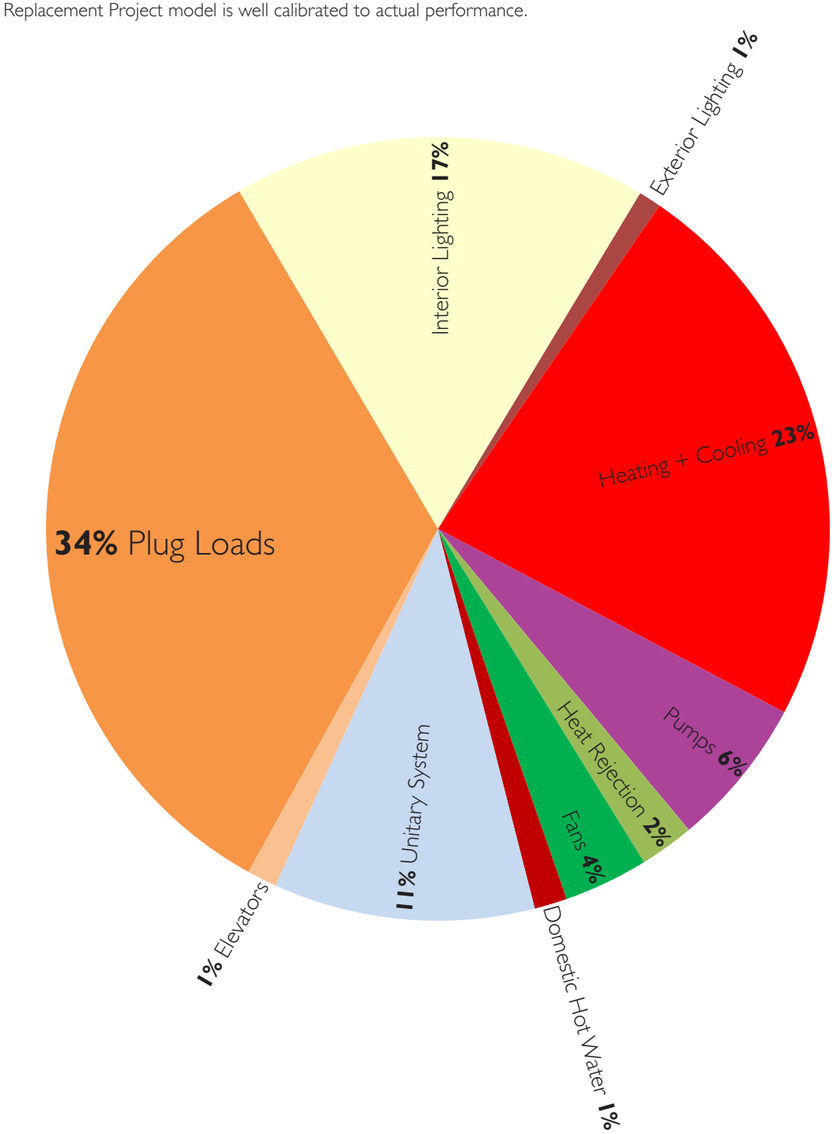


*Energy costs assumption
$0.067/kWh elect.
$0.938/therm gas

FEDERAL CENTER SOUTH: METERED ENERGY BREAKDOWN

MODELED VERSUS METERED ENERGY PERFORMANCE

To confirm the validity of our energy model and the rationality of our assumptions, we compared our energy performance breakdown to the metered energy performance at Federal Center South. Although the climates are not identical, the systems that we have the most control over in design - the HVAC and lighting systems - are modeled to perform within a few percent of the metered performance of these systems at Federal Center South. This indicates that, although we are in the early design phase of the project, our 1063 Block Replacement Project model is well calibrated to actual performance.



CONFIDENTIAL RECORD

HIGH PERFORMANCE DESIGN NARRATIVE | WHAT MATTERS

ENERGY PERFORMANCE SENSITIVITY AND INPUTS

SCHEDULE OF OPERATION

Responsibility: Tenant **Assumption:** Weekdays 6am to 6pm (except 24/7 spaces)
No weekend work, ASHRAE 90.1 load profiles

This category covers the amount of time and the quantity of equipment that is on throughout the year including - lighting systems, tenant equipment, and HVAC systems. This study assumes 12hour week day only operating hours (6am to 6pm - except for 24/7 spaces). It also assumes that lighting and equipment are operated per ASHRAE 90.1 load profiles - with less than 10% of lights and equipment are on overnight. This is indicative of occupants shutting off lights and computers when they leave.

If the office space is operated for more than 12 hours a day or computers and/or lights are left on over night, it is expected that energy can be 10% to 15% greater than modeled.

CENTRAL PLANT SYSTEMS

Responsibility: Design Team **Assumption:** Stand alone heating + cooling system

Our system has a number of features that enable high performance:
1. the cooling units in the zone operate at a higher supply water temperature than typical air based VAV systems. This enables more use of high efficiency water side economizer and higher efficiencies on the chiller (particularly compared to the campus chilled water system).

2. heating is done hydronically to enable the use of a heat recovery chiller (also referred to as a heat pump) that sources heat from a 50ton ground loop. This configuration is 3 to 4 times more efficient than a standard chiller and is optimized to meet nearly 70% of the annual heating load. Supplemental boilers are used for peak heating.

Use of hydronic systems future proof the building as it is now ready to tie into high efficiency district systems when those systems become available.

LIGHTING

Responsibility: Design Team **Assumption:** 0.7 W/SF + controls

The lighting design achieves the targeted light levels in the space with at a high efficiency 0.7 W/SF of lighting load density coupled with daylight and occupant sensors. The variation in energy is based on higher lighting power densities, variation due to occupants leaving lights on is covered under the schedule of operations sensitivity bar.

BUILDING FORM

Responsibility: Design Team **Assumption:** As Shown

During the competition phase the design team looked at a number of building forms. With respect to energy, the selected form considers access to daylight and the associated lighting energy reduction, the massing and the associated heating and cooling, and the occupants access to operable windows which can reduce energy usage when employed for passive cooling.

DOMESTIC HOT WATER

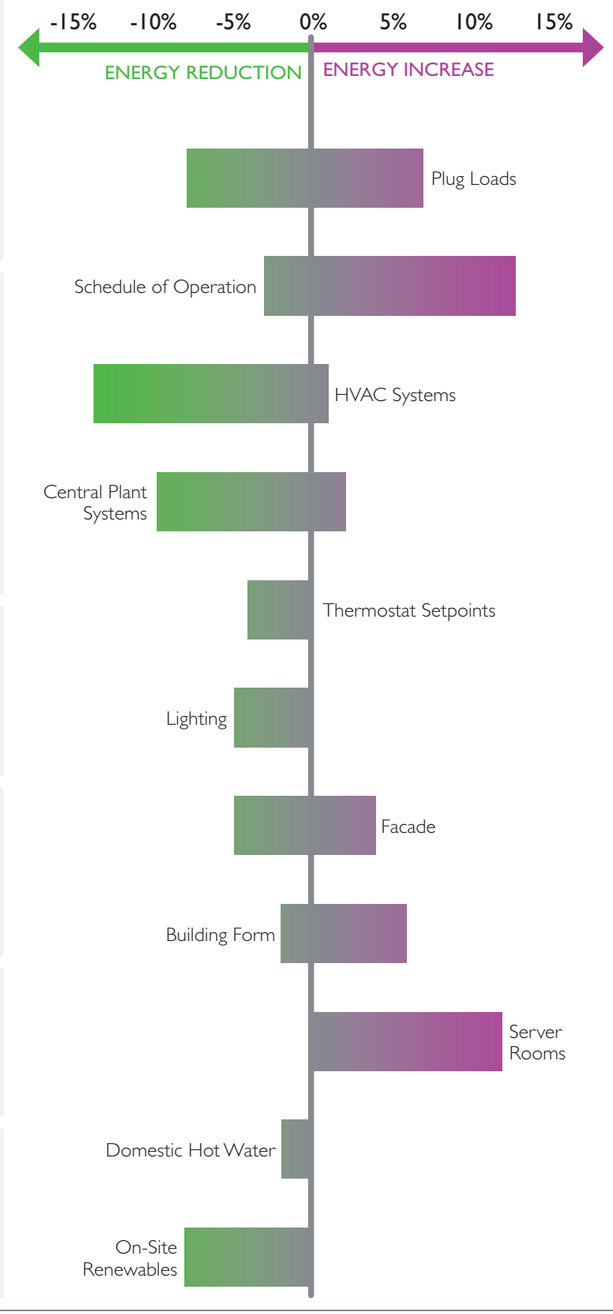
Responsibility: Design Team **Assumption:** High Efficiency Plumbing

Domestic hot water energy is only expected to make up a small portion of the overall energy usage in an office building. However, by simply reducing the water flow through showers and faucets, the energy required to heat water in the building can be reduced.

ON-SITE RENEWABLES

Responsibility: Design Team **Assumption:** None - Solar Ready

The base design does not include any installed on-site renewables for the project as these are typically the least cost effective energy reducing strategy and are considered after the energy efficiency strategy has been fully developed. The building is solar ready and we are carrying a betterment to incorporate solar power on the roof that can reduce energy consumption by 7%



PLUG LOADS

Responsibility: Tenant **Assumption:** 0.75 W/SF

Plug loads in offices typically range from 0.5W/SF to 1.5 W/SF or higher. Based on research, experience, and the improvements in energy performance of office equipment, our modeling uses 0.75 W/SF. The design team has almost no control of the plug load in the space, even though it is such a large impact on performance. To help us optimize energy performance, our team is carrying a betterment to execute a plug load study on the future tenant's, current space. This will help us define an acceptable plug load, allow us to optimize our systems for the expected plug load, and provide guidance to future tenants on opportunities for them to reduce plug loads and save energy.

If the tenant requires higher or lower load equipment (0.5 to 1.5W/SF), energy performance can move +/- by 5% to 10%.

HVAC SYSTEMS

Responsibility: Design Team + Tenant **Assumption:** Occupant Enabled System

The strategy we are carrying is the Occupant Enable System discussed in the "Mechanical Systems Options" portion of this report. This system saves energy by being off when outside air temperature are appropriate for passive cooling. Occupants can open their windows if they feel warm, or activate the system via wall mounted switches - ventilation air is always provided and window operation is not necessary for breathing, only for cooling. Our energy model and published performance isn't accounting for the full savings that the occupants can enable by using their windows appropriately. This means that, as modeled, our system uses slightly more energy than a sophisticated chilled beam system - the Active Energy Saver Option. However, the occupants can enable energy parity between the two systems by properly operating their windows and reducing the cooling and fan energy.

THERMOSTAT SETPOINTS

Responsibility: Design Team **Assumption:** 68 Winter, 76 Summer

Temperature setpoints are based on the RFP documents and provide a wide enough band to support energy savings and passive cooling.

Adaptive thermal comfort bands can be adopted in spaces equipped with operable windows to further improve energy performance

FACADE

Responsibility: Design Team **Assumption:** 56% WWR
Center of Glass:
Uvalue = 0.28 btu/h-ft^2-K, SHGC = 0.27,
VLT = 0.64

Glass performance and amount of glass will have energy impacts on heating, cooling, and daylight harvesting/lighting energy. The glass assumed in the model is a high performance glass with a balance of good insulating value to keep the building warm in the winter, a low SHGC to block solar gain and enable the low energy cooling system, and a high VLT to allow in natural daylight. This coupled with the well balanced 56% glass which is low enough to allow for energy performance without sacrificing views or access to natural light.

The facade also includes external shading tuned to orientation and blinds to protect against direct sun and visual discomfort.

SERVER ROOM/IDF ROOM

Responsibility: Tenant **Assumption:** 7% of plug load,
25kW constant load
219,000 kWh/yr

Server rooms can have a tremendous impact on building energy performance. The RFP includes an electrical design requirements call for a 150kW service for the server room/IDF. If this load were to run 24/7, even at 15% diversity, it would equate to 3.4kBtu/sf/yr, around 10% of the total building's energy.

HIGH PERFORMANCE DESIGN NARRATIVE | OLYMPIA CLIMATE OPPORTUNITIES

TYPICAL DAILY TEMPERATURES

SUMMER:

During this warm season the building will require cooling during the day however, temperatures overnight are mild. Overnight cooling and/or a morning pull-down may not be required for most of the summer. Further, these mild overnight temperatures indicate that a night flush strategy could prove beneficial.

MID-SEASON:

For the majority of the year, outside air temperatures are ideal for passive cooling. The diurnal swing is minimal, indicating that manual operation of windows is an acceptable strategy - even if windows were left open over night, the energy impacts would be small.

WINTER:

During the cold season, low but not freezing temperatures mean that little heat has to be added to the ventilation air, particularly if heat is recovered from the exhaust air leaving the building. The diurnal swing is almost unnoticeable again supporting manual window operation - windows stay closed during the day and at night.

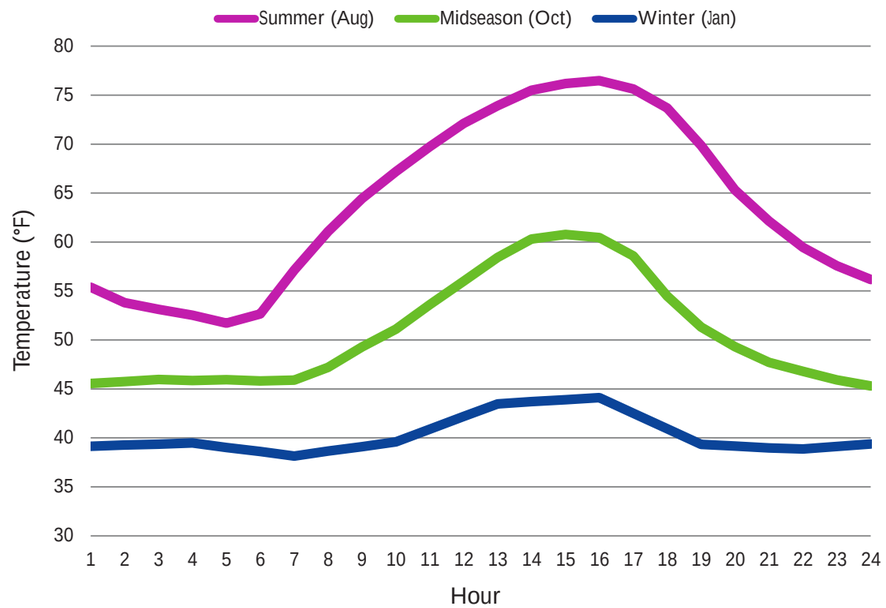
WET BULB TEMPERATURE

The wet bulb temperature is an indication of how cold we can cool water, using just evaporation - typically done with a cooling tower. The low wet bulb temperatures in Olympia enable us to get cool water with 79% of the time with just a cooling tower which is, 3 to 4 times more efficient than a new high efficiency chiller or the campus chilled water loop. The more often we can operate in this mode - water-based economizer mode - where we use direct evaporation for our cooling, the less energy we will use.

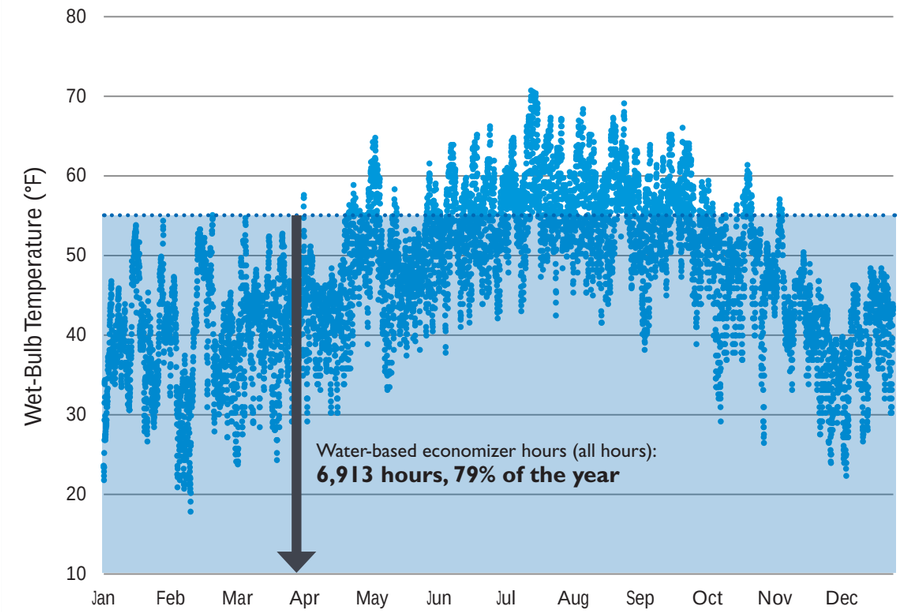
COOLING AND HEATING

A broad brush investigation of weather indicates that Olympia is a heating dominated climate with ample opportunity for air based economizer as well as passive cooling via operable windows. A traditional system can still require cooling for 19% of the year, however, a building that is equipped with passive cooling via operable windows only requires cooling for 7% of the year.

TYPICAL DAILY TEMPERATURE BY SEASON



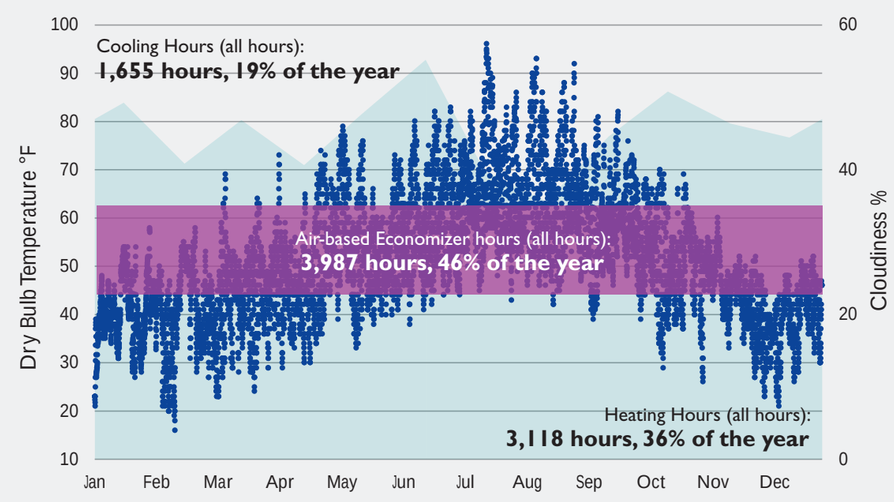
WET BULB TEMPERATURE



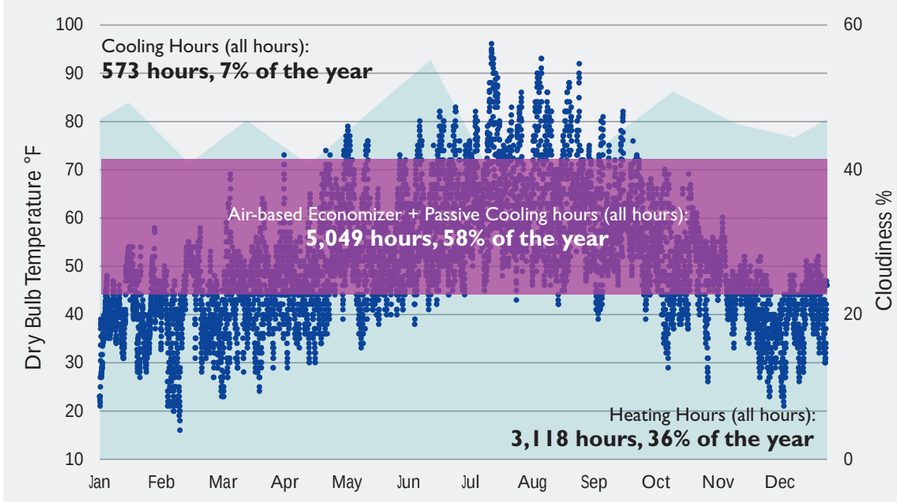
COOLING AND HEATING HOURS

Average Monthly Cloudiness • Daytime Dry Bulb Temperature

AIR BASED ECONOMIZER ONLY



AIR BASED ECONOMIZER + PASSIVE COOLING



CONFIDENTIAL RECORD

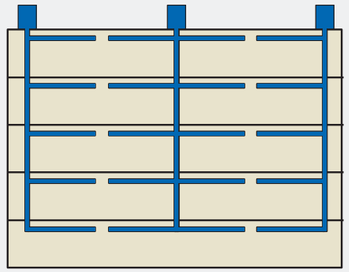
HIGH PERFORMANCE DESIGN NARRATIVE | MECHANICAL SYSTEM OPTIONS

1 BASELINE SYSTEM

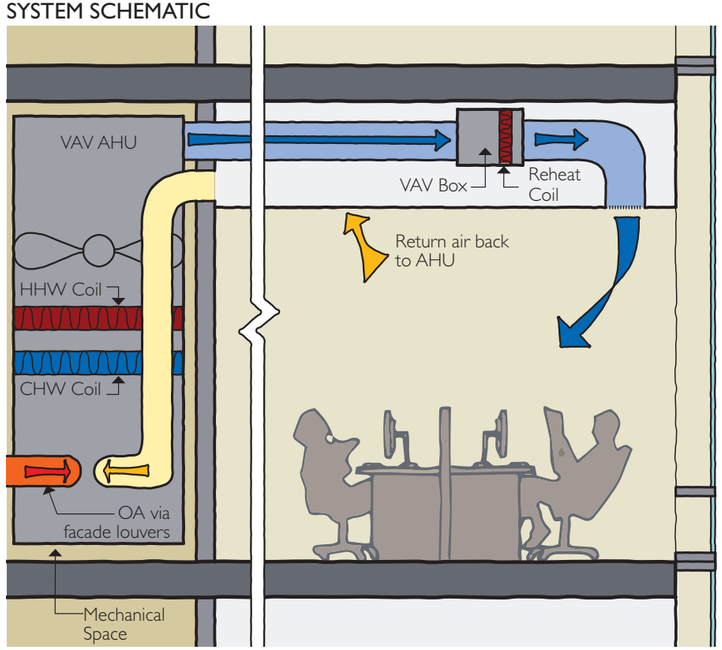
SYSTEM DESCRIPTION

Overhead VAV
Central air handling units (AHUs) are located on the roof of the building. These deliver air through large ducts to the occupied office zones. In cooling, the AHUs deliver more air to handle the cooling loads. In heating, VAV boxes in the zone heat the supply air as necessary.

SPACE REQUIREMENT DIAGRAM



SYSTEM SCHEMATIC

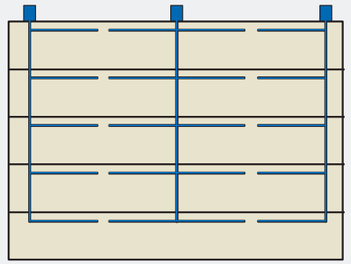


2 ACTIVE ENERGY SAVER

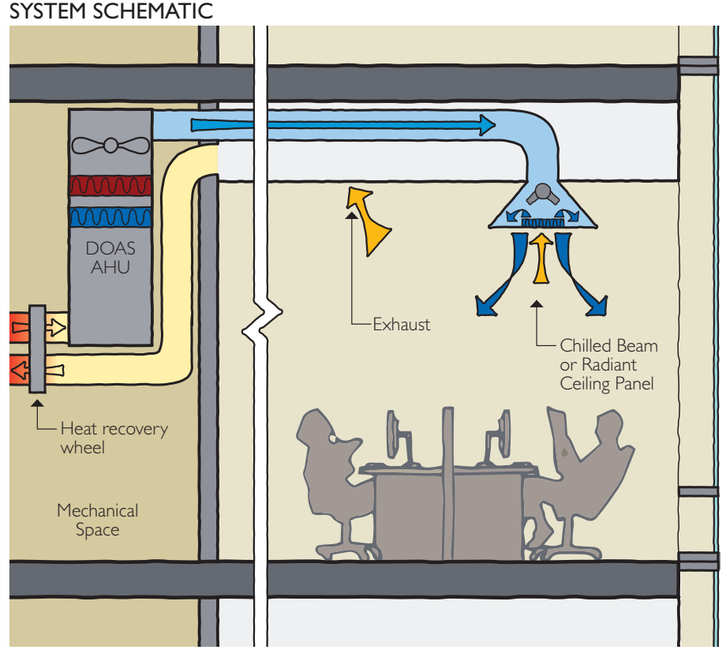
SYSTEM DESCRIPTION

DOAS System Coupled with In-Zone Active Chilled Beams
Dedicated outside air units (DOAS AHU) are located on the roof. The ventilation air travels through small duct work to the office zones. In-zone active chilled beams provided radiant heating and cooling as required.

SPACE REQUIREMENT DIAGRAM



SYSTEM SCHEMATIC

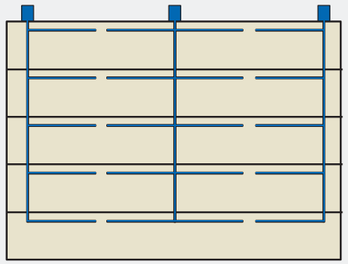


3 OCCUPANT ENABLED SYSTEM

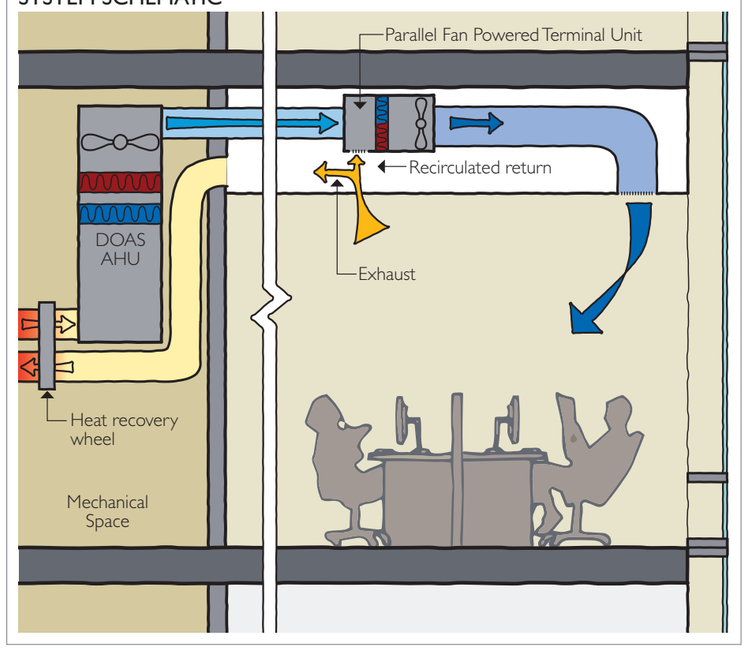
SYSTEM DESCRIPTION

DOAS System Coupled with Parallel Fan Powered Terminal Units
Dedicated outside air units (DOAS AHU) are located on the roof. The ventilation air travels through small duct work to the office zones. Fan powered terminal units (FPTU) with individual heating and cooling coils at each zone provide additional space conditioning as required. When loads are low and outside air temperatures right, the FPTUs are turned off, and occupants rely on operable windows for passive cooling.

SPACE REQUIREMENT DIAGRAM



SYSTEM SCHEMATIC



MECHANICAL SYSTEM OPTION COMPARISON

● Positive ● Neutral ● Negative

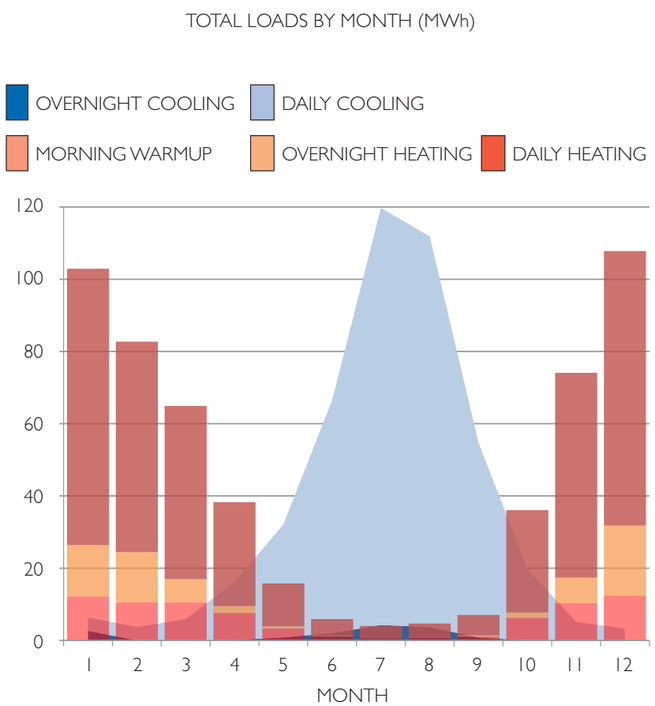
OPTION	COST	FLEXIBILITY	ENERGY PERFORMANCE	OCCUPANT CONTROL	OCCUPANT COMFORT	AIR QUALITY	ALLOWS PASSIVE COOLING	DUCT SIZE	FLOOR TO CEILING HEIGHT	AHU CONFIG.	COMPLEXITY OF OPERATION	SYSTEM NOISE	MAINTENANCE SIMPLICITY	OPTIMIZATION THROUGH M+V
1 Baseline System	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Neutral	Neutral	Negative	Positive
2 Active Energy Saver	Negative	Negative	Positive	Negative	Neutral	Positive	Negative	Positive	Positive	Positive	Positive	Positive	Positive	Positive
3 Occupant Enabled System	Neutral	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Neutral	Neutral	Neutral	Positive

HIGH PERFORMANCE DESIGN NARRATIVE | MODES OF OPERATION | ANNUAL LOADS - OVERVIEW

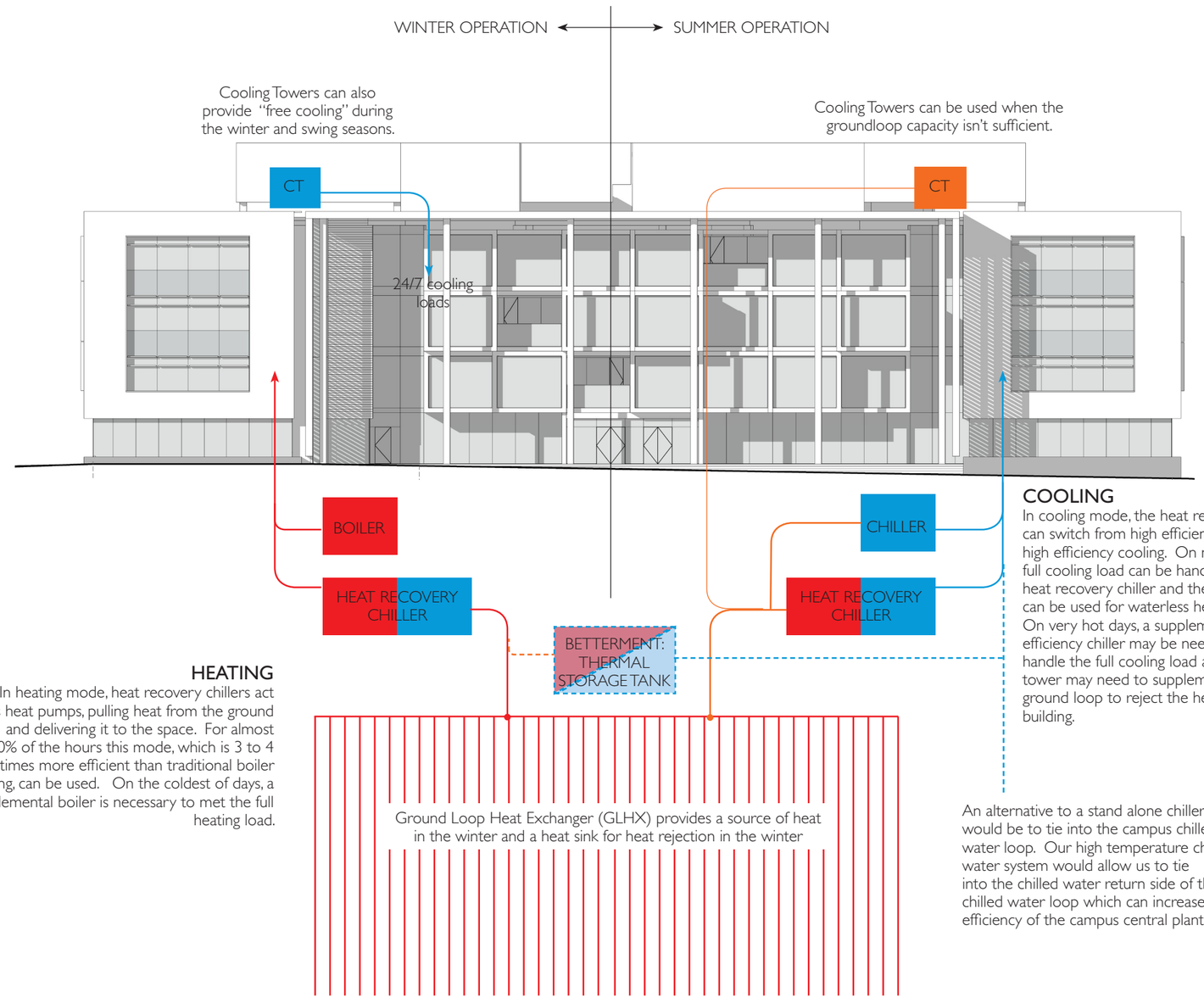
CENTRAL PLANT ANNUAL LOADS ANALYSIS

The total monthly heating and cooling loads were taken out of the model to assess the building's seasonal performance and to validate energy performance opportunities. We found:

- An imbalance of heating and cooling in the winter and summer months with cooling dominance in May through to September. This indicates limited benefits from a daily thermal storage tank. Note that this model does not include 24/7 data room loads.
- Morning warm up and overnight heating make up 25% to 30% of the heating load in January and December.
- There is almost no overnight cooling
- Annually, the total HVAC load is 55% heating and 45% cooling. This is a well balanced load and indicates the applicability of a Ground Loop Heat Exchanger.



CENTRAL PLANT MODES OF OPERATION



HEATING

In heating mode, heat recovery chillers act as heat pumps, pulling heat from the ground and delivering it to the space. For almost 70% of the hours this mode, which is 3 to 4 times more efficient than traditional boiler heating, can be used. On the coldest of days, a supplemental boiler is necessary to met the full heating load.

COOLING

In cooling mode, the heat recovery chiller can switch from high efficiency heating to high efficiency cooling. On most days, the full cooling load can be handled by the heat recovery chiller and the ground loop can be used for waterless heat rejection. On very hot days, a supplemental high efficiency chiller may be needed to handle the full cooling load and a cooling tower may need to supplement the ground loop to reject the heat from the building.

An alternative to a stand alone chiller would be to tie into the campus chilled water loop. Our high temperature chilled water system would allow us to tie into the chilled water return side of the chilled water loop which can increase the efficiency of the campus central plant.

CONFIDENTIAL RECORD

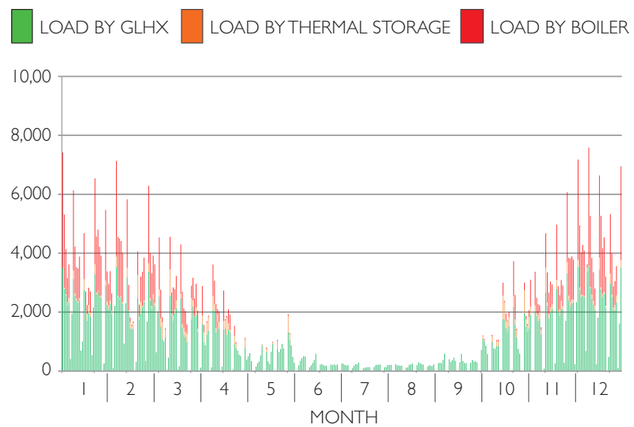
HIGH PERFORMANCE DESIGN NARRATIVE | HEATING MODES | ANNUAL LOADS - HEATING SOURCES

CENTRAL PLANT HEATING LOADS ANALYSIS

The total daily heating loads were analyzed to help size the GLHX and estimate the contribution of a thermal storage tank. It was found that:

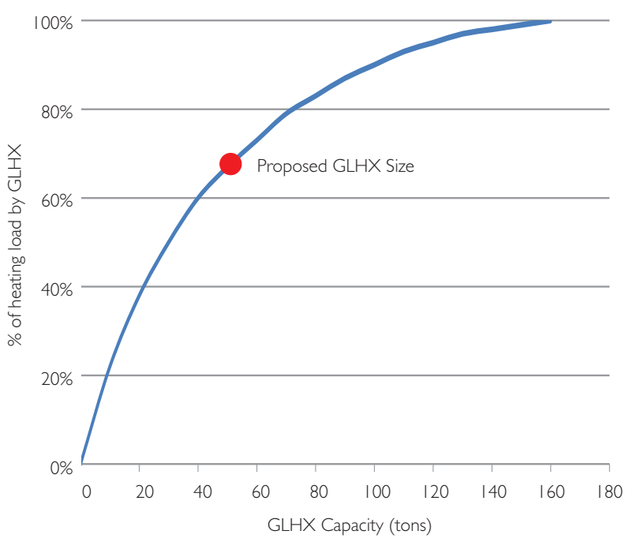
- A 50ton GLHX handles 2/3 (67%) of the annual heating load
- A 800kWh thermal storage tank does 6% of the total heating load (A phase change material based thermal storage tank would be about 1/3 of the size)
- The boilers handle the remaining 27%

TOTAL DAILY HEATING LOADS (KWH)

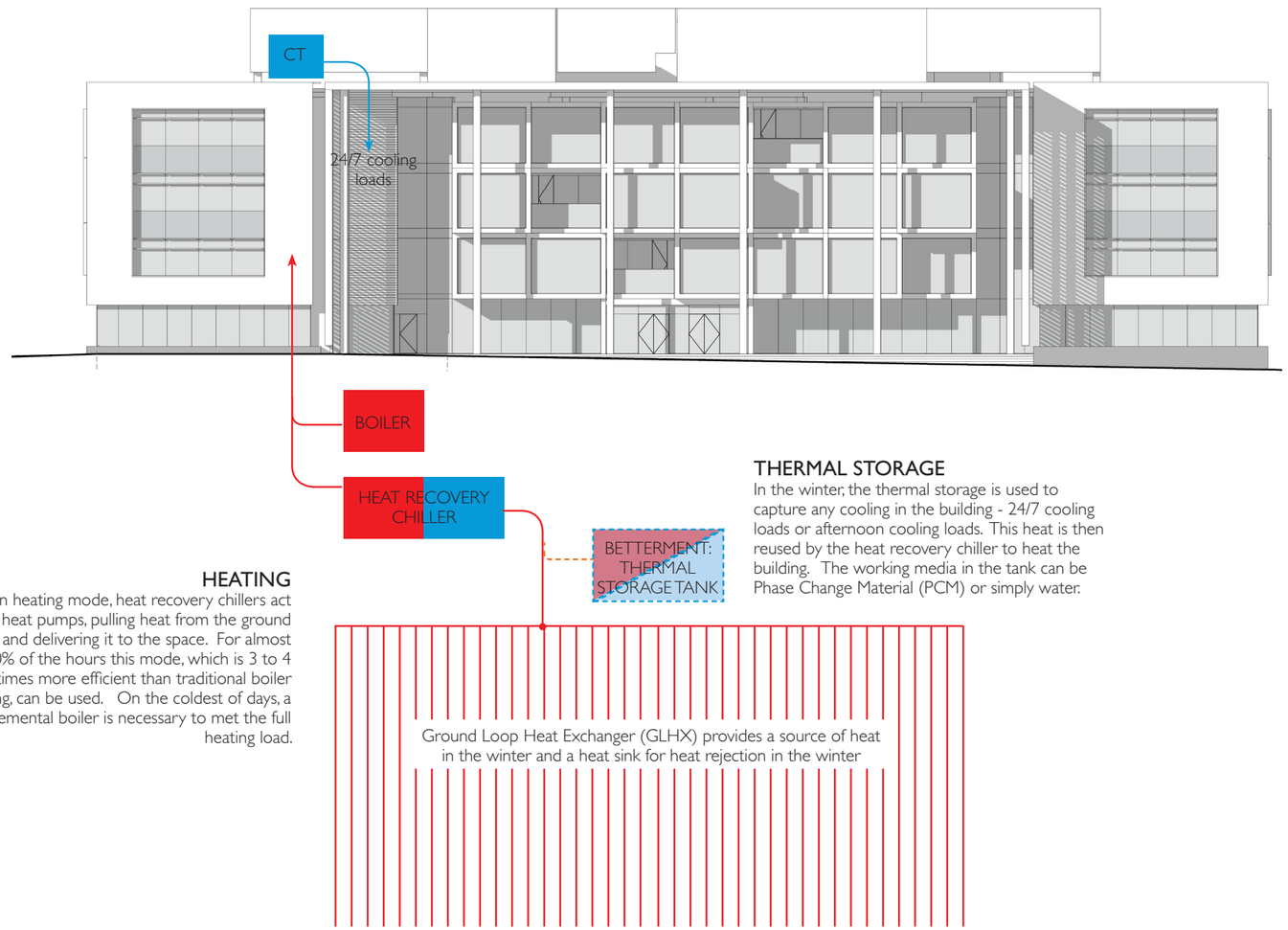


GROUND LOOP HEAT EXCHANGER SIZING

The model was run with various GLHX sizes to optimize the size and benefit of the ground loop.



CENTRAL PLANT MODES OF OPERATION: HEATING SEASON



THERMAL STORAGE

In the winter, the thermal storage is used to capture any cooling in the building - 24/7 cooling loads or afternoon cooling loads. This heat is then reused by the heat recovery chiller to heat the building. The working media in the tank can be Phase Change Material (PCM) or simply water.

HEATING

In heating mode, heat recovery chillers act as heat pumps, pulling heat from the ground and delivering it to the space. For almost 70% of the hours this mode, which is 3 to 4 times more efficient than traditional boiler heating, can be used. On the coldest of days, a supplemental boiler is necessary to met the full heating load.

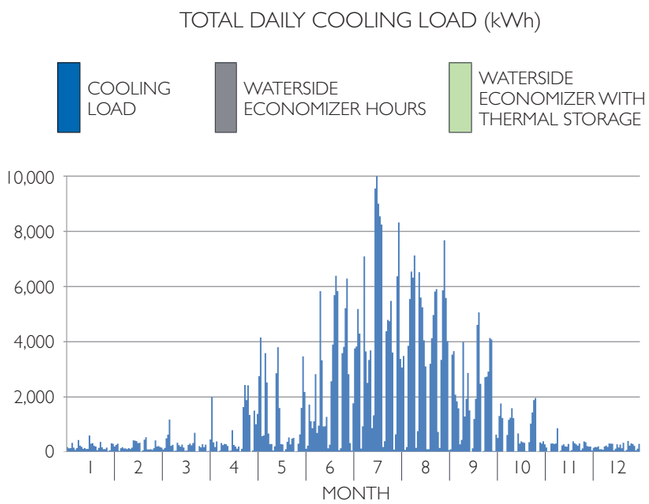
HIGH PERFORMANCE DESIGN NARRATIVE | COOLING MODES | ANNUAL LOADS - COOLING SOURCES

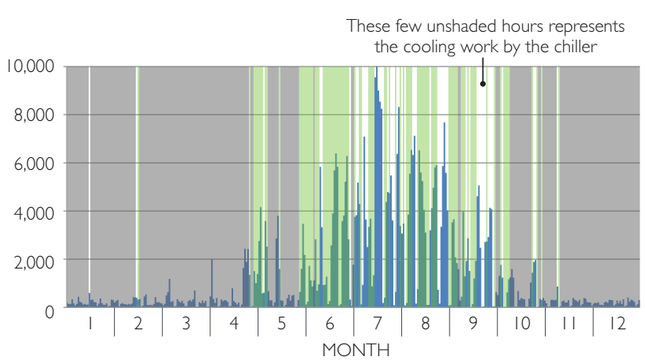
CENTRAL PLANT COOLING LOADS ANALYSIS

The proposed design includes a stand alone chilled water plant. We believe there are serval advantages to this configuration over connection to the district loop:

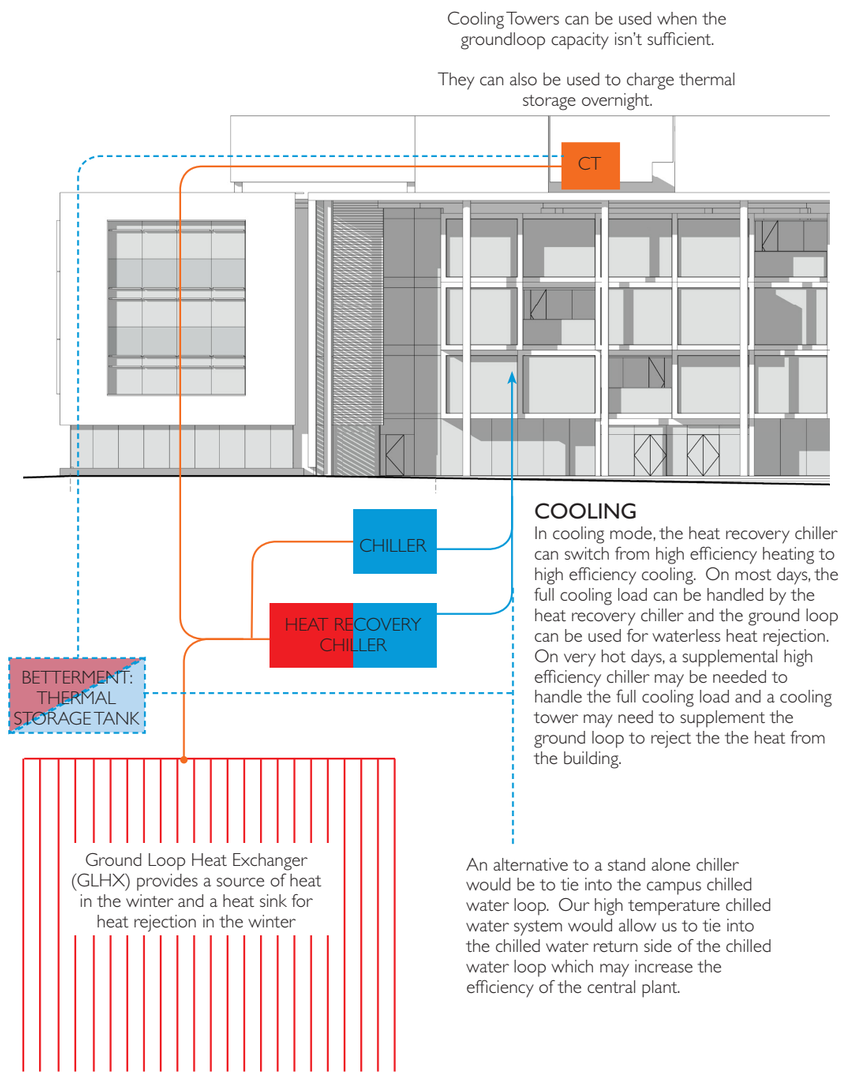
1. The heat recovery chiller is a necessary piece of equipment for heating and can be dual purposed for cooling in the summer. Only a smaller, supplemental chilller would be needed to manage peak loads in this stand alone configuration.

2. The cooling tower allows us to operate in waterside economizer - a mode of cooling that is 5 to 6 times more efficient than the campus chilled water plant. If a thermal storage tank were integrated in the design, it could be used to store chilled water generated by the cooling tower overnight. This mode of operation is similar to ice storage except that we would store low energy chilled water rather than ice resulting in both reduced peak loads and energy savings. The graph below shows the opportunity for water side economizer (shaded in grey) and for overnight thermal storage (shaded in green).





CENTRAL PLANT MODES OF OPERATION: COOLING SEASON



COOLING

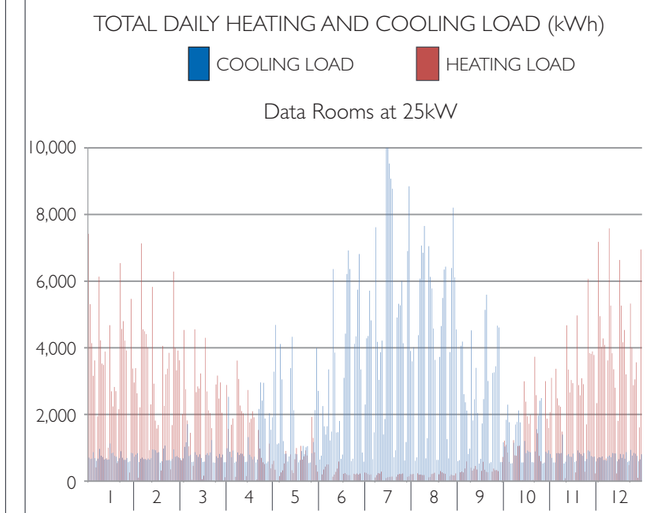
In cooling mode, the heat recovery chiller can switch from high efficiency heating to high efficiency cooling. On most days, the full cooling load can be handled by the heat recovery chiller and the ground loop can be used for waterless heat rejection. On very hot days, a supplemental high efficiency chiller may be needed to handle the full cooling load and a cooling tower may need to supplement the ground loop to reject the the heat from the building.

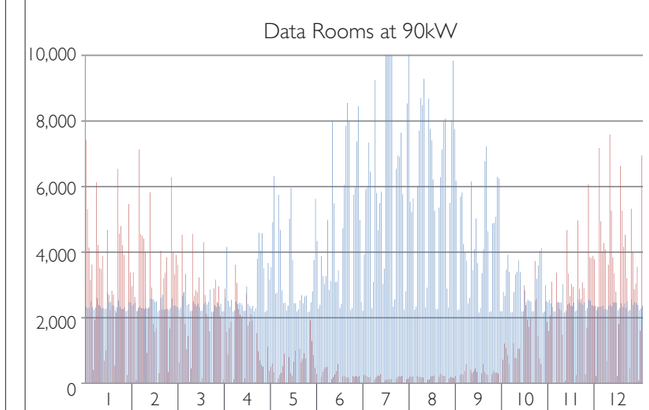
An alternative to a stand alone chiller would be to tie into the campus chilled water loop. Our high temperature chilled water system would allow us to tie into the chilled water return side of the chilled water loop which may increase the efficiency of the central plant.

DATA ROOMS AND 24/7 COOLING LOADS

The loads shown assume almost no 24/7 data room cooling loads. It is most likely this will not be the case. A larger data room will have little impact on the modes of operation discussed, however the data room will be used as a source of heat in the winter and can enable greater use of a thermal storage tank. The two graphs below show the building with a 25kW and a 90kW constant 24/7 data center load.

- In the 25kW case, the 30,000 gallon of 800kWh tank now does 13% (previously 6%) of the heating load, saving the building 0.85 kBtu/sf/yr.
- In the 90kW case, the 30,000 gallon of 800kWh tank now does 14% of the heating load, saving the building 0.91 kBtu/sf/yr. The incremental increase in savings indicates that the tank is reaching capacity in this case.
- In the 90kW case, if a 60,000 gallon of 1,600kWh tank were used, the tank would handle 16% of the heating load, saving the building 1.04 kBtu/sf/yr.





CONFIDENTIAL RECORD

HIGH PERFORMANCE DESIGN NARRATIVE | WATER | BUILDING WATER BALANCE

PROPOSED DESIGN WATER PERFORMANCE

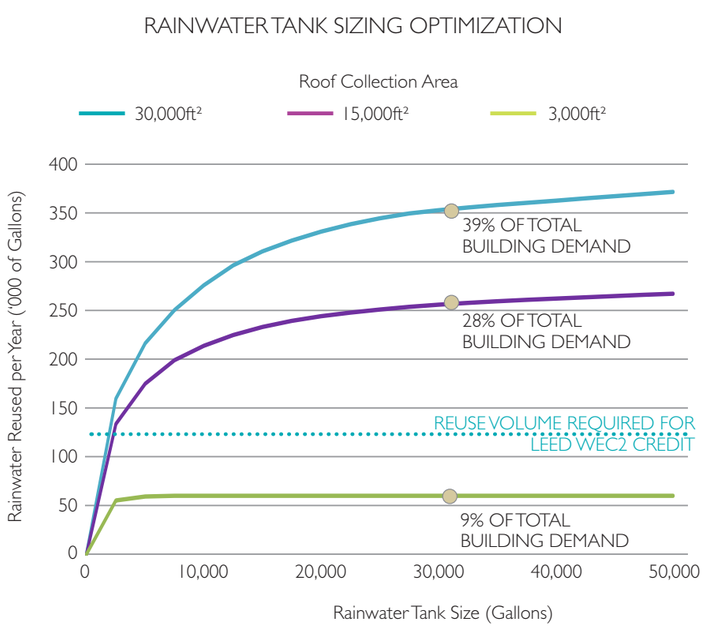
The proposed design relies on water efficient fittings and fixtures to reduce water consumption within the building. Assuming 800 full time occupants as outlined in Section 5 of the RFP, this strategy enables the building to use 35% less water than a typical building. The proposed water fixture flow rates are:

	UNIT	LEED BASELINE	PROPOSED
LAV FAUCETS	GPU/GPC	0.25	0.13
KITCHEN SINKS	GPM	2.20	1.60
SHOWERS	GPM	2.50	1.80
TOILETS	GPF	1.60	1.28
URINALS	GPG	1.00	0.125
TOTAL FLUSH FIXTURE USE	KGAL/YR	874	558
TOTAL BUILDING WATER USE	KGAL/YR	1,404	907

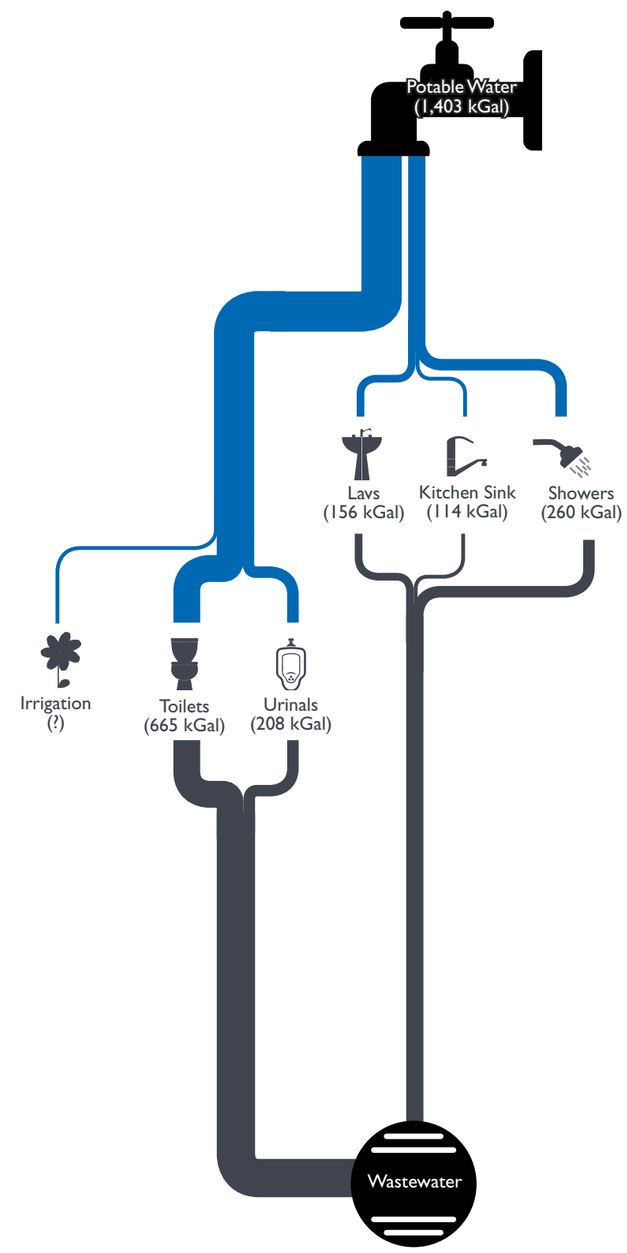
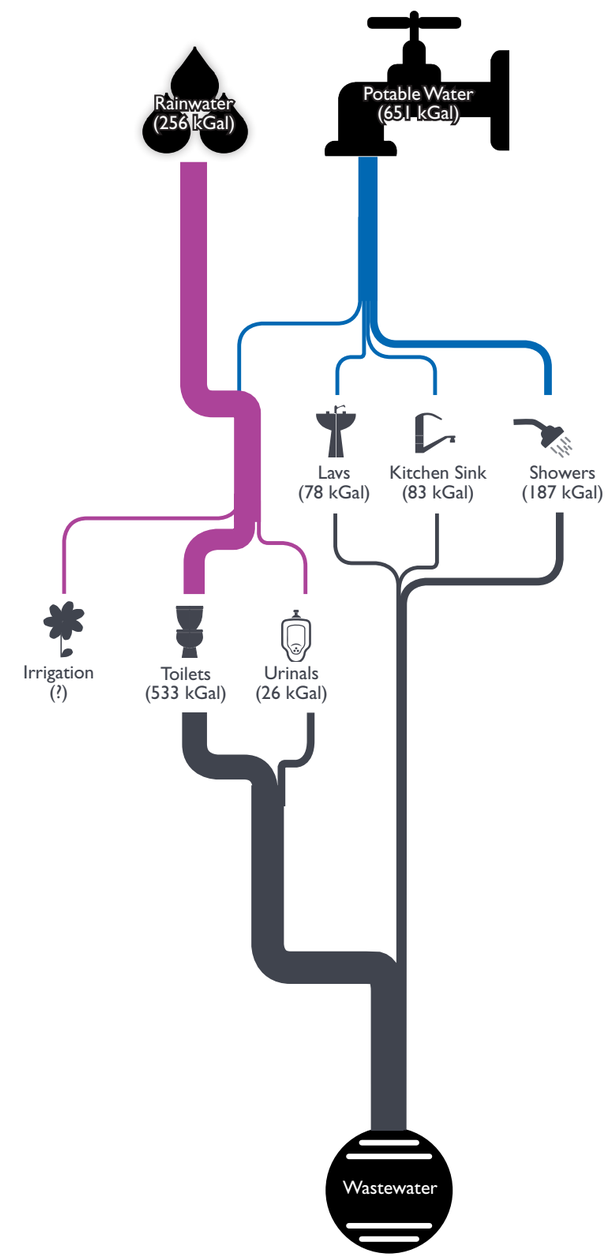
RAINWATER REUSE BETTERMENT

The building can integrate rainwater capture and reuse as a potential betterment. The ideal size for the tank is between 20,000 and 30,000 gallons. Beyond this point the tank reaches a point of diminishing returns.

If we are just chasing after LEED points, we can get away with a much smaller tank of 5,000 to 10,000 gallons. This size tank would be sufficient to achieve all points under WEc2 and WEc3.



BASELINE WATER USAGE



PROPOSED WATER USAGE + BETTERMENT