MEP FACILITY ASSESSMENT AND RECOMMENDATIONS
for
ANCHORAGE PUBLIC SCHOOL & BOARD OFFICE
11400 Ridge Road
Anchorage, KY 40223

Introduction

On October 13, 2025, a walk-thru of the Anchorage School and Board Office was conducted by Glen Knauer and Jeff Frohlich with Shrout Tate Wilson (STW) Engineers, Craig Aossey with Gary Scott & Associates (GSA) Architects and Thomas Kinnaird with Anchorage Schools. The purpose of this walk-thru was to observe existing mechanical and electrical systems throughout the facility and note their current condition. STW was also given a copy of the latest KFICS audit information related to existing MEP system components within the building. The assessment below contains the observations made along with additional information.

Building Descriptions

The school building is a two-story structure with a lower-level mechanical room area. The building consists of original 1911 construction plus building additions in 1925, 1926, 1986, 1988, 1991 and 1998.
The board office building is a single-story building built in 1981.

Mechanical HVAC Systems

The school building incorporates a variety of HVAC systems as follows:

- Steam Heating via gas-fired boilers and related accessories
- Steam Radiator heating
- Split System Classroom Unit Ventilators with direct expansion (DX) cooling and steam heating
- Split System Classroom Fan Coil Units with DX cooling and steam heating
- Split System Air Handling Units with DX cooling and steam heating
- Split Systems DX cooling and electric heating
- Split System Heat Pumps
- Packaged Rooftop Air Conditioning Unit with DX cooling and gas heating
- Packaged Rooftop Air Conditioning Unit with DX cooling and electric heating
- Packaged Rooftop Air Conditioning Unit with gas heating only

Mechanical Plumbing Systems

The school building incorporates the following plumbing related items:

- Multiple Gas-fired Water Heaters
- Plumbing piping from 1911 to 1998.

Mechanical HVAC Equipment Condition

It appears that most if not all of the HVAC equipment in the building is operational. However, from the KFICS audit report provided it appears that most of the HVAC equipment in the building ranges 1985 to 2011 in terms of installation dates (14 – 40 years old). Life expectancy of most of the current equipment in the building is fifteen (15) years.

Major equipment concerns are as follows:

- Steam Boilers

  - One of the two boilers is approximately 30 years old and no longer functional.
  - Replacement of this boiler would require the reworking of the existing steam header supply piping to meet current applicable codes.
  - The other boiler was installed in 2012 and now is the only boiler that can provide steam to the building. Life expectancy of this boiler is 25 years.
- Refrigerant
  - Most all the direct expansion (DX) equipment in the building utilizes R-22 or R-410A refrigerant. These refrigerants are no longer being manufactured although they are still available at a price premium. Any repairs to these systems could require the need for these refrigerants. Any replacement of split system equipment would now require replacement of both indoor air handling unit and outdoor condensing and the possible replacement of the refrigerant piping connecting the two.
- Outside Ventilation Air
  - It appears that a good majority of the split system equipment within the building does not incorporate the introduction of outside air into the building. This is a building code requirement that is not currently being met.
- Equipment Age
  - Most HVAC equipment is nearing the age recommended for replacement.

<u>Current Energy Usage</u>

Anchorage School provided STW with their electric and gas bills for the past year (November 2024 to October 2025) indicating monthly usage and associated costs for the school and the board office. This information was used to determine the following:

- Based on a total square footage of 99,825 square feet, the school/board office had an Energy Use Intensity (EUI) of 65.26 kBTU/SF. This is a measure of energy usage for the entire facility. A breakdown is as follows:
  - Annual Electric Usage – 672,600 kWh
  - Annual Electric Cost - $88,441.74
  - Annual Gas Usage – 42,495 ccf
  - Annual Gas Cost - $38,842.29
  - Total Annual Energy Cost - $125,284.03

<u>Mechanical Recommendations – Planning for the Future</u>

Recommendations are as follows:

- Eliminate all steam related systems
  - Steam is inefficient
  - Current steam and steam condensate piping systems are old and subject to leaks and associated repair costs.
- Replace existing HVAC systems with a more energy efficient system such as water-source heat pumps utilizing geothermal (first choice) or gas boiler/cooling tower (second choice) as the heating/cooling source.
  - Geothermal would be the most efficient system with EUI in the range of 20-30 kBTU/SF (Entire Building); 10-20 kBTU/SF (HVAC Only).
    - This would cut the current utility usage by more than half.

- Geothermal well field with vertical bores would be required on-site. A test well would be recommended to determine geothermal viability.
- Geothermal offers low maintenance and minimal space for equipment.
- Tax Incentives are now available for the implementation of geothermal systems/equipment. STW has helped and is currently helping owners with the proper avenues to explore these incentives. See additional tax incentive information within this document.

- Gas Boiler / Cooling Tower option is still efficient providing EUI in the range of 30-40 kBTU/SF (Entire Building); 15-25 kBTU/SF (HVAC only).
  - This would cut the current utility usage by more than half.
  - Space would be required for boiler(s) and cooling tower and miscellaneous hydronic equipment.
  - Large exterior area not needed as with geothermal.
  - Lower first cost compared to geothermal.
  - Probably no tax incentives are possible.

- For more information related to water source heat pump systems, see additional information contained within this document.

<u>Mechanical HVAC Recommendations – Line-Item Cost Estimates</u>

1. Water Source Heat Pump System for school utilizing Geothermal - $4,280,715.00
   a. Based on school building only - 95,127 square feet X $45.00/square foot
2. Water Source Heat Pump System for school utilizing Boiler/Cooling Tower - $3,519,699.00
   a. Based on school building only - 95,127 square feet X $37.00/square foot

<u>Mechanical Plumbing and Fire Protection Recommendations – Line-Item Cost Estimates</u>

1. Plumbing Upgrades of Fixtures and Piping - $713,453.00
   a. Based on school building only - 95,127 square feet X $7.50/square foot
2. Fire Protection Sprinkler System Upgrades as/if required - $380,508.00
   a. Based on school building only - 95,127 square feet X $4.00/square foot
   b. Only portions of building may require upgrades

<u>Electrical Distribution System</u>

The school and board offices share a common electrical service entrance, which originates at the board office. The incoming voltage to the facility is 120/240V/3-phase.

Types of electrical distribution equipment is as follows:

- Fusible-switch type Square D QMB switchgear
- Fusible-switch type Square D I-Line distribution panels
- Circuit breaker type Square D I-Line distribution panels
- Circuit breaker type Square D NQ branch panels

Electrical Lighting System

The school and board offices have a combination of LED, T8 fluorescent, HID (metal halide) and incandescent light fixtures.

- Most of the lights are fluorescent, but approximately ¼ of them have been replaced with LED.
- The auditorium and stage have new theatrical lights and digital controls.
- The majority of spaces have standard, toggle-type light switches for control.

Electrical Emergency Power Systems

The facility utilizes battery packs for emergency power in lights, for fire alarm, and other critical systems back-up, such as for their data/voice network and security/access systems. There is not an emergency generator.

Electrical Low-voltage Systems

The school and board offices utilize the following low-voltage systems:

- The fire alarm system is a traditional, addressable-type fire alarm system that is manufactured by Silent Knight.
- The intercom / paging / digital clock system is manufactured by Dukane.
- The facility utilizes access control / card readers and CCTV security cameras.
- The main entrances to both the board office and the school utilize A/V door monitoring systems with remote door releases.
- The facility utilizes an Avaya digital telephone system, for staff inter-communications and outside calls.
- The data network has a main wiring closet (MDF) and several smaller IDF closet locations. Cabling for the data network is a combination of Cat 5 and Cat 6.

Electrical Wiring and Wiring Devices/Receptacles

Although it is unlikely that any old knob & tube-type wiring is still connected and energized from back in the 1920’s, this type of very old, exposed wiring has been seen inside of walls during recent interior renovation projects. Any wiring from the 1986 additions and on would be considered as modern wiring that is still in use today. Standard, modern style 120V duplex receptacles are located throughout the facility, both in the existing walls and in surface raceway.

Lightning Protection

The old masonry chimney currently appears to be lightning protected.

Electrical Equipment Condition

It appears that most, if not all of the electrical equipment is currently operational. Life expectancy for electric panels, switchgear and transformers is between 25-40 years. The typical life expectancy of all other electrical systems equipment is 15-20 years. Another consideration is that electrical codes and life safety codes have changed several times since much of the equipment in the board office and school has been installed, and as such, no longer meet current requirements.

Electrical equipment concerns are as follows:

- Electrical switchgear, panels and transformers installed during the additions/renovations in 1986, 1988 and even 1991 are past their useful life and could begin to have problems, such as circuit breakers nuisance-tripping, circuit breakers not tripping when they need to (freezing up) which is a fire hazard, loose connections, overheating bus bars, etc.
- The building incoming electrical service utilizes a voltage that is dated and not typically used for new commercial facilities.
- Any light fixtures that have not already been replaced with LED fixtures should be replaced, as older type technologies could begin to start failing, and many types of older lamps/bulbs are no longer being manufactured. This even includes old fluorescent light fixtures that were retrofitted with LED-type tubes, since the original fixture is still the main source of power for the replacement tubes. The non-LED fixtures also do not meet current US energy codes.
- Battery packs for exit lights, egress lights and emergency light fixtures and systems such as fire alarm, data and security have life spans of just 3 to 5 years and should be tested and replaced as needed.
- While the current fire alarm system is fairly new, it does not meet all of the current life safety code requirements.
- The intercom system is manufactured by a company that no longer manufactures intercom systems, and as such, repair and replacement parts could possibly become difficult to obtain.
- The data network still utilizes quite a few Cat 5 drops throughout the building, which is no longer the industry standard to keep up with current technologies.
- According to the most recent KFICS facility audit report, there are only 4 exterior cameras, located on the exterior of the building. This leaves a lot of “blind” spots on both the exterior and the interior.

<u>Electrical Recommendations – Planning for the Future</u>

Recommendations are as follows:

- Replace switchgear and branch panels that are from the 1980’s with new, to avoid any potential safety hazards with the old equipment. When doing this, provide more spare capacity in these panels for potential, additional future electrical loads. Also refer to other building voltage recommendations related to the switchgear and panels on the next page.
- Provide all electric switchgear and panels, new or existing, with transient voltage surge suppression devices. This is used to protect the electrical equipment and circuits they feed, as well as any sensitive electronic, low-voltage systems that are fed from the electrical distribution system. This helps to protect against lightning strikes, any surges that are internal to the building’s electrical system, as well as any utility-generated spikes, surges and transients.
- Install a lightning protection system for the building. While the existing tall chimney appears to have lightning protection for it, it is also recommended to have lightning protection on the entire roof of the school and on all of the roof-mounted HVAC equipment.
- Switch emergency and life-safety loads from battery backup to a generator. The lifespan of a generator is typically 25-30 years, while batteries should be changed every 3 to 5 years. Batteries for lights, fire alarm systems, data, security, etc. can cost $100+ each (plus the labor/time to change them), and there may be several hundred of them in a school. During an emergency, batteries for life safety lights and fire alarm are required to last 90 minutes. A generator can run indefinitely, as long as fuel (natural gas or diesel) is available, and typical diesel fuel tanks are

sized for the generator to run at least 24 hours. Natural gas generators will continue to run as long as needed, unless gas service is interrupted, which is not common. Also, a generator can power other larger loads in the event of a major power outage, such as building heat and kitchen walk-in coolers and freezers.

- Replace all remaining non-LED light fixtures with LED fixtures, including fixtures that are currently retrofit with LED tubes in old fluorescent fixture housings. This is required to meet current energy codes and will also save the school district a considerable amount of money. Current estimates show that it can save around $1.10 per square foot annually by switching from fluorescent and HID light sources to LED.
- Install an energy code compliant, networked lighting controls system, with occupancy sensors, daylight sensors, smart switches with dimming capability, etc. This type of system in school districts similar in size to Anchorage Independent have shown energy savings of $10,000.00+ annually. If a full-blown networked lighting controls system is not desired, a more basic, but still code-compliant non-networked system can be installed that consists of small stand-alone systems on a room-by-room basis.
- Have a licensed electrician check existing wiring types at electric panels, light fixtures, receptacles, etc. to make certain that all in-use wiring is of a modern, code-compliant type, and that no unsafe, outdated types of electrical wiring are still in use. Only the 1911, 1925 and 1926 portions of the building would need to be reviewed.
- Replace existing receptacles throughout the board offices and the school. Wiring devices / receptacles have a life expectancy of approximately 20 years in commercial installations. Over time, the connectors inside of the receptacles can get loose from constant use and cause bad connections, inadequate grounding or shorts. Also make certain that the type of receptacles installed are correct, based upon the installation location. Install tamper resistant, GFCI, or plug-load type receptacles where needed and/or required by code. At some locations, it may be desired to have receptacles with built-in USB (Types A and C) outlets.
- Replace all existing Cat 5 cabling runs, including related Cat 5 jacks and patch panels, with Cat 6 or Cat 6A cabling and components. The benefits of Cat 6 / 6A over Cat 5 are, superior performance by providing higher speeds, increased bandwidth and better resistance to interference.
- Provide a new web-based video surveillance system, with numerous cameras on both the exterior of the building and the interior. According to the previous facility assessment, the current system has only 4 exterior cameras. The additional cameras can help to deter and/or prevent vandalism and break-ins. Also, having numerous cameras throughout the facility can help with potential liability issues, and even lower insurance rates.
- Even though the existing fire alarm system is fairly new, it regrettably does not meet current code requirements for fire alarm systems in schools. New fire alarm systems for schools are required to be voice-evacuation type systems that utilize speakers instead of horns to transmit spoken warning messages directing the occupants what to do during an emergency. These are adaptable communication systems that can be used for a wide range of situations, such as bomb threats, active shooter incidents or severe weather events. These systems can provide specific, customized instructions beyond just fire evacuation, such as directing people to shelter in-place or away from specific areas. However, the installed fire alarm system installed at the school is currently functioning as it should and would not have to be replaced at this time, unless there are major modifications / equipment relocations such as you would have with a significant renovation, or if major components of the system break down and must be replaced with new.

- This electrical system recommendation would be a much larger undertaking but is worth considering. When the original electric services were first installed, a 120/240V, 3-phase system was very common, and most buildings were fed with that voltage from the utility company. As the school has been upgraded and added-to over time, the original 240V, 3-phase system continued to be expanded instead of being replaced with a more modern, efficient and common commercial building voltage.
  - 120/208V systems are now standard in commercial buildings because they are more versatile. They provide both 120V single-phase power (from any one of the three phases and the neutral wire) and 208V three-phase power (from any two of the three phases). This setup allows for a single power source to run a wide variety of equipment, from small single-phase appliances to large three-phase motors. Common branch panels can be used to feed both single-phase and three-phase loads.
  - 240V systems are less common in modern commercial buildings. While they can be set up to provide 240V three-phase and 120V single-phase power, the 120V single-phase is derived from using a center-tapped transformer. This creates a “high-leg” or “wild-leg” on the third phase, which can be dangerous to 120V rated equipment. The type of system used at the school requires transformers being located throughout the school and board office to separate the three-phase and single-phase loads, and separate panels are needed, since the 240V three-phase circuits and 120V single-phase circuits can’t be fed out of the same panel without creating a potentially dangerous electrical condition. The additional transformers and panels required for a 240V, three phase service create a lot of additional equipment cost and take up a lot more space in mechanical rooms.
  - Note that a change of service entrance voltage could possibly require the replacement of some larger equipment loads, such as larger HVAC units. However, most modern HVAC equipment is made to be able to be fed from multiple voltages.
  - During any potential renovation of the electrical system to replace old panels and switchgear, it is definitely worth considering changing the electric service to 120/208V instead of remaining with 120/240V. Prior to making a switch to 120/208V, a building audit of large 3-phase equipment could be conducted to see what pieces of equipment would be affected by such a voltage change. Most likely, very few pieces of equipment would be affected.
- Have testing done to see if an ERCES system is needed, and install the system if tests determine that one is required. An ERCES (Emergency Radio Communications Enhancement System) is currently required in all new buildings and as a part of all major building renovations, IF first responders cannot get satisfactory radio coverage throughout all areas of the building. During a fire, first responders must be able to communicate with each other, from command posts outside of the building to the firemen inside of a burning building, via their radios. Due to certain types of construction, radio signals cannot transmit from outside of a building to all areas inside of a building, similar to when you lose cell phone coverage inside of some buildings. ERCES systems are now required by code to be installed into buildings where there is not adequate signal coverage. There are computer simulator programs that can determine if a radio frequency can be transmitted throughout all areas of the building. The building plan is input into the program, with all building materials (wall types, thicknesses, doors, window types, structure, etc.) and the program generates the local fire departments radio frequency into the building plan to see what areas receive the signal or not. Sometimes an entire building must have an ERCES system installed to meet code, sometimes only small areas of the building require it. Sometimes a system is not

required at all. It is possible to forego the computer analysis if the local fire department is willing to conduct tests with their actual radios throughout all areas of the building.

Electrical Recommendations – Line-Item Cost Estimates

1. Replace switchgear and panels from 1980's era additions - $232,176.00
2. Provide surge protection for switchgear and all panels - $74,869.00
3. Install a complete lightning protection system - $62,390.00
4. Provide a generator system for emergency power - $114,799.00
5. Replace all non-LED lights with new LED fixtures - $748,690.00
6. Install an energy code-compliant lighting controls system –
    - **a.** Fully networked system - $499,125.00
    - **b.** Stand alone, room-by-room system - $299,475.00
7. Electrician to check all wiring in 1911 thru 1926 areas - $43,170.00
8. Replace all existing receptacles with new - $74,869.00
9. Replace all Cat 5 cables/jacks/patch panels with Cat 6a - $199,648.00
10. Provide a new exterior and interior security camera system - $249,563.00
11. Replace existing fire alarm system with code-compliant voice-evac system - $199,650.00
12. Replace existing 120/240V/3 system with safer 120/208V/3 system - $1,197,900.00
13. Have ERCES testing done – Free for local fire department radio test.
14. Install ERCES system if required by testing - $149,738.00

Note that all estimates above include complete demolition of old equipment and systems and furnishing/installing of new equipment and systems.

Additional Water Source System Information

How they work

Geothermal WSHP

- A water (or water/antifreeze) loop is buried in the ground (vertical boreholes or horizontal trenches) or sometimes uses groundwater/ponds. The loop serves as the heat source in winter and the heat sink in summer.
- Each water-source heat pump (WSHP) uses that loop: in heating mode it extracts heat from the loop, in cooling mode it rejects heat to the loop.
- Because the ground temperature is relatively stable (~50-65 °F in many U.S. locations) the loop operates within moderate temperature swing.
- There is no boiler or cooling tower needed for the loop.

Boiler/Cooling Tower WSHP

- A conventional water-loop is installed in the building: the loop connects multiple WSHP units. That loop requires a heat-rejecting device (cooling tower) when the loop becomes too warm (in cooling mode) and a heat-adding device (boiler or sometimes a dedicated heater) when the loop becomes too cold (in heating mode).
- In cooling mode: WSHP units reject heat into the loop → loop grows warmer → cooling tower rejects that heat to ambient air.
- In heating mode: WSHP units extract heat from the loop → loop becomes cooler → boiler adds heat to the loop to maintain loop temperature and ensure adequate supply for heat pumps.
- The loop temperature range is often broader and depends on tower/boiler operation.

Pros & Cons

Geothermal WSHP: Pros

- High efficiency: Because the loop temperature is moderate and stable, the heat pumps operate in more favorable conditions (less extreme temperature lift needed). For instance, a GHP (geothermal heat pump) can use the earth loop and often “use 25-50% less electricity than comparable conventional systems”.
- Lower peak loads on auxiliary systems (no large cooling tower/boiler in many cases) → fewer major mechanical pieces.
- Long life & fewer moving parts underground: The loop field can last 50+ years in many cases; indoor equipment often 20+ years.
- Quiet exterior: No big outdoor condenser/cooling tower sounds (depending on configuration).
- Good for simultaneous heating & cooling loads within a building: When one zone is cooling and another heating, the loop can balance loads and reduce need for external heat reject/heat add.

Geothermal WSHP: Cons

- High upfront installation cost: Drilling boreholes or trenching loops and installing antifreeze loops etc. can be expensive.
- Site constraints: Soil/geology, space for horizontal loops, drilling availability, permitting. Some sites may not be suitable.
- Loop design and thermal balance is critical: If you keep rejecting heat into the ground over many summers without sufficient extraction in winter (or vice versa) you can gradually raise loop temperature and reduce efficiency.
- Slightly more complex upfront hydronic design; if retrofitting an existing building, may be disruptive.

Boiler/Cooling Tower WSHP: Pros

- More flexible site-wise: Especially in urban or retrofit buildings you may already have a mechanical plant with cooling towers/boilers, making integration easier.
- Lower initial capital (in some cases) compared to drilling loops for a geo system (depending on building size/site).
- Works well when building has mixed heating/cooling zones so you can reuse reject heat from some zones to heat others via the loop (thermal energy transfer) which yields savings.
- Easier to expand/incremental units: Individual WSHP units can be added to the loop as needed.

Boiler/Cooling Tower WSHP: Cons

- The cooling tower and boiler add to operations & maintenance: They need water treatment, blowers, fans, make-up water, drift control, etc.
- Efficiency may be lower than the geo-loop case because the loop is subject to more extreme temperature swings (tower usually rejects to ambient wet-bulb, boiler may be required).
- The tower and boiler mechanical plant may require more floor/roof space and maintenance.
- Potential for more energy usage when external heat add/reject devices operate inefficiently (especially if tower approach is poor or loop temperatures drift).
- Water quality issues: cooling tower loops are subject to fouling, scaling, corrosion, etc.

Maintenance Considerations

Geo-Water Loop WSHP

- Underground loop: usually very low maintenance because it's closed, buried, sealed. Minimal risk of corrosion/fouling.
- The heat pumps themselves require typical preventive maintenance: filters, coils, refrigerant checks, fan motors, controls.
- Monitoring loop pump energy and flow; ensuring temperature change across the loop is correct; ensuring loop temperature remains within design envelope.
- Because loop is underground, any fault can be more costly to repair (drilling, access).
- Good operations monitoring: keep the loop within design range, avoid overcooling/overheating the ground field, avoid thermal drift.

Tower/Boiler WSHP

- Cooling tower: requires water treatment (chemicals, blowdown, drift, scaling, corrosion, make-up), fan motors & drives, basin cleaning, drift eliminators, lead/lag, seasonal inspections.
- Boiler: if used, needs regular boiler maintenance (combustion inspection, flue checks, controls, expansion tanks).
- Loop and pumps: ensure proper flow, pump head, variable-flow control, water quality in closed loop if there's an isolating heat exchanger.
- WSHP units: filters, coils, refrigerant checks, fans, controls just like geothermal case.
- Because there are more components (tower, boiler) there are more maintenance items and risk of downtime.
- Water quality and fouling are larger concerns in tower/boiler loops. Flow loss or loop temperatures drifting will degrade performance more noticeably.

Energy & EUI Implications

It's harder to pin exact EUI (energy use intensity) because it depends on climate, building load, system design, controls, and building occupancy. But some indicative numbers and trends are as follows:

Geothermal WSHP

- According to U.S. Department of Energy, geothermal systems take advantage of relatively constant ground temperature (40°-70°F) which increases efficiency and reduces energy use.
- One study found that for applicable buildings, implementing a ground-loop geothermal water-to-water heat-pump system yielded ~51% energy savings across HVAC end-uses (heating, cooling, fans, pumps) compared to baseline conventional hydronic systems.
- Typical geothermal water source heat pump equipment efficiencies:
    - Cooling EER (energy efficiency rating) = 18-30 EER
    - Heating COP (coefficient of performance) = 3.5-5.0 COP

Tower/Boiler WSHP

- Typical conventional water source heat pump equipment efficiencies:
    - Cooling EER (energy efficiency rating) = 12-18 EER
    - Heating COP (coefficient of performance) = 3.0-4.0 COP
- Note that these ranges assume the loop is reasonably controlled and well-designed.
- The ability to transfer heat between zones (simultaneous heating/cooling) gives a benefit.
- However, because the loop needs the tower/boiler to maintain loop temperature extremes, the overall system energy (including pumping, tower fans, make-up water, boiler) can increase EUI relative to an ideal geothermal scenario.

Summary / Comparison

- The geothermal WSHP typically achieves **higher efficiency**, lower HVAC energy use, and therefore lower HVAC EUI (for the same building loads) because the heat source/sink environment is more favorable (stable ground, less extreme temperature lift).

- The tower/boiler WSHP gives flexibility and relatively high efficiency compared to traditional air-source or chiller/boiler systems, but it doesn't reach quite the same level of efficiency as geothermal in many cases (all else equal) because of the added equipment and potentially higher loop delta temperatures / less favorable heat sink/source conditions.
- EUI (energy use intensity) for the building will depend on non-HVAC loads too, so these percentages apply within the HVAC portion of the EUI, not necessarily whole-building EUI.

Which to choose / Practical considerations

When deciding between the two, consider:

Site & building profile

- If the building has a large simultaneous heating & cooling load (e.g., interior zones warm while perimeter cooled), the water-loop WSHP (tower/boiler) can capture "free" heat transfer between zones, increasing efficiency.
- If you have adequate land, favorable geology, or existing ground loop infrastructure may be viable for a geo-water loop system.
- If you are in a retrofit scenario and have existing cooling towers/boiler, integrating a tower/boiler WSHP may reduce sunk cost and disruption.
- If you are in a constrained site (no land for loop, high drilling cost) then tower/boiler may be more feasible.

Budget & lifecycle cost

- Geothermal has higher upfront cost; you need to evaluate payback via energy cost savings.
- Tower/boiler WSHP may have lower installation cost (especially if mechanical plant exists) but somewhat higher operating cost.
- Factor in maintenance costs: tower/boiler adds more maintenance (water treatment, fans, pumps). Geothermal has a big upfront investment but lower ongoing plant complexity.

Efficiency goals / sustainability

- If the goal is lowest possible HVAC energy use and building is new construction, geo is very attractive.
- If you want electrification (no fossil boiler) and stable performance, geo is strong.
- If you want flexibility and somewhat lower capital cost, tower/boiler WSHP is still a high-efficiency option.

Maintenance & operational risk

- For tower/boiler WSHP: you must maintain tower water quality, ensure control loop temperatures, monitor loop pump/flow, and ensure boiler/tower plant reliability. Poor maintenance can cause large degradation.

- For geothermal: ensure the loop is well designed, properly sized (so as not to overheat or overcool the ground field), maintain pumps/flow, but fewer external components; however if any loop failure (leak, freeze, infiltration) repairs may be expensive.

Tax Incentives for Geothermal Energy (U.S. Overview, 2025)

Geothermal energy projects — whether for electricity generation or direct use (heating/cooling) — benefit from several tax incentives, especially in the U.S. Here's a breakdown:

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1. Investment Tax Credit (ITC) – Most Used for school applications

- What it is: A federal tax credit based on a percentage of the cost of installing a qualifying geothermal system.
- Rate (as of 2025):
  - 30% - 40% for systems meeting domestic content and labor requirements under the Inflation Reduction Act (IRA, 2022).
  - Could be reduced if certain conditions are not met.
- Eligible projects:
  - Geothermal electricity plants.
  - Geothermal heat pumps (for homes and businesses).
- Direct pay & transferability: Some entities (like nonprofits, schools, hospitals, and local governments) can receive the credit as direct payment instead of a tax offset.

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2. Production Tax Credit (PTC)

- What it is: A per-kilowatt-hour (kWh) tax credit for electricity generated by renewable sources, including geothermal.
- Rate (2025): Approximately 2.6–2.8¢ per kWh (adjusted for inflation).
- Eligibility: Projects must begin construction before the end of 2032 to qualify.

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3. Accelerated Depreciation (MACRS)

- What it is: Allows geothermal systems to be depreciated over 5 years for tax purposes.
- Bonus depreciation: Through 2026, projects can qualify for 80% bonus depreciation, meaning 80% of project costs can be written off in year one.

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4. State and Local Incentives - Many states offer additional benefits, such as:

- Property tax exemptions.
- Sales tax exemptions on geothermal equipment.
- State-level renewable energy credits (RECs).