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Advisory Team - Sustainability & MEP Systems 6

Project Name:	Medford High School	Project Number:	25100
RE:	Advisory Team - Sustainability & MEP Systems	Meeting Date:	09/23/2026
Prepared by:	Brenda Lam, Martine Dion	Meeting Number:	06
Distribution:	Attendees		

Owner

- ☑ Libby Brown, *SBC Member, Architect at Goody Clancy*
- ☐ Suni Dillard, *Medford Resident, Sustainability Leader at HMFH Architects*
- ☑ Austin Ditz, *Medford Resident, Solar Project Manager*
- ☐ Audrey Feitor, *Medford High School Teacher*
- ☑ Jenny Graham, *Chair of SBC, Vice Chair of School Committee*
- ☐ Chris Hogan, *Medford Resident*
- ☐ Elisabeth Krautscheid, *Medford Resident, MassSave Decarbonization Program*
- ☑ Ken Lord, *MPS Chief Operating Officer*
- ☑ Sarah Michelman, *Medford Resident, Sustainable Design Consultant at The Green Engineer*
- ☐ Nicole Morell, *SBC Member*
- ☑ Jessica Parks, *Medford Resident, MIT Energy Efficiency Project Manager*
- ☐ Brenda Pike, *City of Medford Climate Policy Planner*
- ☐ Luke Preisner, *SBC Member*
- ☐ Chris Richard, *Medford Resident, Senior Project Superintendent at Turner*
- ☑ Paul Ruseau, *SBC & School Committee Member*
- ☐ Nathan Scott, *Medford Resident, Capital Construction at Tufts University*
- ☑ Sam Riley, *City of Medford Climate Policy Planner*
- ☑ Alicia Hunt, City of Medford Director of Planning & Sustainability

SMMA & Consultants

- ☑ Martine Dion, *Director of Sustainable Design*
- ☑ Brenda Lam, *Sustainable Design Project Coordinator*
- ☑ Helen Fantini, *Project Manager*
- ☑ Matt Rice, *Principal-in-Charge, Architect*
- ☐ Abigail Ransmeier, *Head of Research*
- ☐ Soala Ajienka, *Architectural Designer*
- ☐ Jamay Li, *Architectural Designer*
- ☑ Emily Ehlers, *Mechanical Engineer*
- ☑ Stella Drizin, *Electrical Engineer*
- ☐ James Job, *Plumbing & Fire Protection Engineer*, AKAL Engineering
- ☑ Rohan Kollu, AKAL Engineering
- ☐ Tommaso Bitossi, Transsolar

Leftfield

- ☐ Jen Carlson, *Project Director*
- ☐ Matt Gulino, *Project Manager*
- ☐ Adele Sands, *Educational Liaison*
- ☑ Linda Liporto, *Director*

Item No.	Action	Discussion
06.01	Record	**Meeting #6 Agenda** • Welcome & introductions • Sustainability Givens Overview • Net Zero Energy & Minimizing Cost of Ownership ◦ Preliminary Life Cycle Cost Analysis (LCCA) Information • Preliminary Solar PV Assessment • Red List Free Materials • Embodied Carbon & Mass Timber • Next Steps
06.02	SMMA	**Sustainability Givens Overview** • The Project Sustainability Givens include the following compliance: ◦ MSBA Green School Policy: ▪ LEEDv4 Silver certification (minimum), compliance with the Stretch Energy Code, LEEDv4 MEP/Building Enclosure and on-going Commissioning funded by the MSBA, and successful achievement of 3 LEED Materials & Resources / Indoor Environmental Quality credits. ▪ Compliance with the Specialized Stretch Energy Code qualifies the project for an additional 3% reimbursement, and successful achievement of 5 LEED Materials & Resources / Indoor Environmental Quality credits qualifies for an additional 1% reimbursement, for a total of 4% total. The Project is targeting the additional 4% MSBA reimbursement. ◦ Specialized Stretch Energy Code compliance: The Project is planned to comply with the Specialized Code with an all-electric HVAC (heating, ventilation, and air conditioning) and DHW (domestic hot water) systems design. ◦ City of Medford Sustainability Givens and Goals including the sustainability requirements motion previously discussed by the School Committee. • The School Committee previously voted on and approved on 07.20.2026 (reviewed at the Sustainability & MEP Systems Advisory Team Meeting on 07.21.2026), the following motion: The Comprehensive Medford High School project shall achieve a minimum of LEEDv4 Silver certification to meet the Massachusetts School Building Authority (MSBA); however the project shall prioritize building performance, occupant health, and lifecycle cost over point accumulation. To that end, the project shall: ◦ **Strive to achieve net zero energy** (as technically feasible) through integrative passive design strategies, all-electric, high-efficiency systems, and on-site renewable energy generation; ◦ **Specify red list free, healthy materials** for all materials except MEP/FP and prioritize LEED healthy materials credits necessary to obtain the maximum IAQ MSBA reimbursement to ensure superior indoor air quality for students and staff. ◦ **Prioritize water efficiency and stewardship** to reduce indoor potable water consumption by a minimum of 30%, while trying to eliminate potable water for irrigation use. ◦ **Minimize the total cost of ownership**, designing operational systems, controls and monitoring to substantially reduce energy, water, and maintenance costs over the life of the building. The long-term cost of operating and maintaining the building shall remain at the forefront of every design decision.
06.03	SMMA	**Net Zero Energy and Minimizing Cost of Ownership** **Preliminary LCCA (Life Cycle Cost Analysis)** • The Project will strive to achieve net zero energy, in alignment with the approved School Committee motion. Net Zero Energy (NZE) is achieved with a high-performing energy-efficient building, building occupant behaviors supporting the low energy use consumption, and sizing of the Solar PV system to produce enough energy annually to offset the power grid consumption of the facility.

- The Project will target a predicted Energy Use Intensity (EUI) of 35 kBtu/SF/year (goal), which reflects the realistic impact of the CTE programs. The project will meet the Specialized Stretch Energy Code by including passive design strategies, a super-insulated enclosure, triple-glazing, all-electric HVAC, and plug load management. The pEUI (predicted Energy Use Intensity) represents the combined and total energy use of electricity, including lighting, mechanical systems, plug loads, refrigeration into one metric: kBtu/SF/yr. While typical high school projects often pursue a 25-30 pEUI goal, high schools with CTE programs present a higher energy use per SF, due to the CTE program equipment (kitchens, automotive, carpentry, etc.)
- Life Cycle Cost Analysis (LCCA) is used to assess and compare the associated initial and operating costs of building systems (HVAC) over the life cycle of the building (50 years), and includes estimated initial costs, replacement costs, maintenance costs, energy costs and associated energy savings (utility), assuming a 3% cost escalation (compounded over 50-year period). Also included in the presentation are the estimated incremental costs, payback, and incentives.
- The Main Building HVAC systems included in the study are the following:
    - Option 1: 100% ground source heat pump(GSHP) - geothermal
    - Option 2: Hybrid 50% GSHP and 50% Air-to-Water Heat Pump
    - Option 3: 100% AtWHP
    - Code Baseline Fossil Fuel Heating & Cooling (Natural Gas Boiler and Water-Cooled Chiller - ASHRAE System #7).
- The Pool Building LCCA HVAC systems will be provided at a later date. While the Pool Renovation is included in the current Project, it is not included as part of the MSBA reimbursement. The Pool has a high energy use intensity (EUI), and its HVAC system is analyzed separately from the main building. The HVAC systems to be included in the Pool LCCA study are the following:
    - Option 1: Air-to-Water Heat Pump (AtWHP)
    - Option 2: Natural Gas Boilers
- The design team noted the site constraints of a 100% GSHP system will required approximately 9 acres area for 800ft bore holes and 12 acres area for 500ft bore holes. A full GSHP system would require drilling in the deed-restricted land of the site. While a hybrid system would require approximately 4.5 acres area for 800ft bore holes and 8 acres area for 500ft bore holes, and will not require drilling in the deed-restricted land. There is approximately 8.6 acres of available site area that does not fall within the deed-restricted land. Please note that the available 8.6 acres (non-deeded area) would be available only after the full demolition of the existing school facility, which triggers the need for a temporary heating and cooling system for 3.5 years, due to the school phasing. The cost of the temporary heating system is included in the LCCA.
- Preliminary SD 50-year Life-Cycle Cost Analysis Overview:

System Type	Required Bore Wells Area (SF/acres)	Location of Bore Wells	Site Staging Impact/ Limits	Initial Cost	50-yr Cost
Baseline - Fossil Fuel System (Baseline)	-	-	-	$77,290,000	**$173,009,000**
Option 1 Ground Source Heat Pump - GSHP	9 acres	Main Parking Lower Field Areas	Temporary HVAC System – 3.5 yrs	$93,417,000	**$164,744,000**
Option 2 Hybrid – GSHP (50%) and AtWHP (50%)	4.5 acres	Main Parking	Temporary HVAC System – 3.5 yrs	$74,279,000	**$142,076,000**
Option 3 Air-to-Water HP (AtWHP)	-	-	-	$62,378,000	**$133,402,000**

    - The geothermal system design would include a temporary HVAC system for 3.5 years
    - The fossil fuel system (baseline) is the most expensive over 50 years.
    - Option 2 Hybrid and 3 AtWHP (100%) have a lower initial cost compared to the fossil fuel system.

- Preliminary SD Incremental Costs/Payback:

System Type	Estimated Installation Costs	Estimated Incremental Costs			Estimated Annual Energy Cost Savings	Estimated Payback
		($) Over Code Baseline [Fossil Fuel]	($) Over GSHP 100%	(%) Over Total Project Cost		Years
Baseline - Fossil Fuel System (Baseline)	$77,290,000					
Option 1 Ground Source Heat Pump - GSHP	$93,417,000	$16,126,000		Included in current budget	$393,258	41 [33 with Incent.]
Option 2 Hybrid – GSHP (50%) and AtWHP (50%)	$74,279,000	($3,011,000)	($19,138,000)	(3.2)%	$334,323	0
Option 3 Air-to-Water HP (AtWHP)	$62,378,000	($14,912,000)	($31,039,000)	(5.6)%	$211,745	0

    - Current PSR budget includes the Option 1: GSHP. Options 2 and 3 would provide a cost reduction from the PSR estimate.
    - Options 2 and 3 do not have a payback because they are less expensive than the fossil fuel baseline.

- Preliminary SD 50-year Life-Cycle Cost Analysis with Costs Breakdown:

System Type	Estimated Installation Costs ($)	Estimated Replacement Costs ($)	Estimated Maintenance Costs ($)	Estimated Energy Costs ($)	Estimated 50-yr LCCA Cost ($)	Estimated Incentives ($) [Mass Save]	Estimated EUI (kBtu/SF/Yr)
Baseline - Fossil Fuel System (Baseline)	$77,290,000	$43,781,000	$5,984,000	$45,954,000	**$173,009,000**		89.2
Option 1 Ground Source Heat Pump - GSHP	$93,417,000	$29,793,000	$5,918,000	$35,616,000	**$164,744,000**	$3,000,000	36.1
Option 2 Hybrid – GSHP (50%) and AtWHP (50%)	$74,279,000	$24,487,000	$6,304,000	$37,006,000	**$142,076,000**	$2,550,000	37.5
Option 3 Air-to-Water HP (AtWHP)	$62,378,000	$25,981,000	$5,146,000	$39,897,000	**$133,402,000**	$2,100,000	40.4

    - Fossil fuel system would have to include renewable energy installation to offset the fossil fuel, per the requirements of the Specialized Stretch Energy code).
    - Option 1 GSHP has the lowest estimated energy costs, but not enough to recuperate the initial cost.
    - For incentives received from the MassSave Incentive Program, the Hybrid is estimated at $2,550,000, and the 100% AtWHP at $2,100,000, vs. the capped $3 Million for the GSHP. Again, the higher incentives for the GSHP are not enough to close the gap on the high upfront costs.
    - Estimated EUI will be adjusted as design progresses. Please note, the usage of the high school during evenings, weekends, and summers is to be factored into EUI. The schedule will be updated as the project progresses.

		• Takeaways: ○ Fossil Fuel baseline initial cost is more expensive vs. hybrid GSHP/AtWHP and 100% AtWHP. GSHP has the highest cost. ○ Challenges with 100% GSHP include higher costs upfront and site bore areas (pending land with deed-restriction outcome). The cost of the Article 97 process is not included. ○ The 100% GSHP option is included in the current project budget. Both alternative options bring first cost reductions. ○ GSHP additional costs bring an estimated 44 yrs. Payback, 33 years with Mass Save incentives. ○ All 3 HVAC system alternatives are less expensive than the fossil fuel baseline over the cost of ownership (50-years). LCCA Discussion • Question: Would there be any impacts on the utility incentives if the high school building doesn't have any gas and the pool would have gas. The design team advised there is already gas connection on site and noted further clarification with National Grid is ongoing. The utility incentives listed exceptions for vocational/education purposes for gas connections. • Question: Would use of a gas boiler at the pool impact the Project's ability to achieve the max MSBA incentive points? Additionally, in order to achieve net zero energy, will we need to size for an electric boiler, etc. for the pool if gas is being used? The design team clarified that the pool is not part of the MSBA scope. The school building will meet the Specialized Stretch Energy Code and will get the 3% MSBA reimbursement. The cost of electrical readiness and PV (if the pool elects for a fossil fuel system) will be included in the Pool LCCA, as the pool has to also meet the Specialized Stretch Energy Code. • Question: Requested clarification on if losing reimbursement rate from MSBA would trigger looking at the cost of an all-electric system. The design team advised they will follow-up with the MSBA on the reimbursement implications. • Question: Since the pool needs to meet the Specialized Stretch Code, will that PV be used to offset the high school? The high school would not be mandated to . PV is sized to install PV as long as it remains all-electric. The pool PV must be sized to offset the pool fossil fuel energy from the natural gas boiler. The design team advised the rooftop structure of the pool is likely to require upgrades to sustain the installation of a Solar PV system. • Question: Does the LCCA account for any potential change in utility tariff that may be associated with going to 100% electric (i.e. demand charges or demand only rate?). The design team advised that there is a possibility that the rates are higher with lower use, however it is not possible to assess at this time. Conventional utility rates' structure are based on "the more you use, the more lower the utility rate for commercial buildings" [vs residential]. The design team advised that the utility companies are re-visiting rate structures and may increase rates, however, pending on the Solar PV system option selection, the project energy use and demand may be much lower. The design team advised they have not had any completed projects to which the rates were higher, however, with cost escalation, the rate per hour and demand charges are assumed to increase. For Net Zero project and battery storage, the system could be managed so that the peak shaving/output from the battery is timed to more than even out the highest charges. The design team plans to review with the utility company. The LCCA energy costs uses a blended rate that includes demand rates and supply, and applies 3% escalation. The baseline is the current demand rate. Rates will are applied to all 3 HVAC options. • Question: What assumptions were used that make the AtWHP lowest maintenance costs? The design team advised that each component is based on previous experience from other projects and industry standards. • Question: Will the gas connection to the pool be the existing gas connection? The design team advised it will need to be moved, because it is planned to be demolished. • Question: Regarding the energy modeling, is the team using the current MHS electric rate, vs the public National Grid rate (MHS kWh rate is lower)? The design team confirmed information received from the City is being utilized, and is compounded by 3% over 50 years. • Question: Regarding the install costs for Options 1 & 2 is the temp HVAC system cost included? If so, does it just include capital costs, or does it include rental, fuel/energy, 3.5 years of maintenance, other? The design team responded, yes, the temporary HVAC system costs are included in Options 1 and 2, as well as the utility energy costs for 3.5-year. • Question: Is the team looking at battery to offset the demand charge? The design team advised that the utility incentives programs are being considered as part of the Solar PV LCCA.
06.04	SMMA	**Mechanical System Selection** • Heat pumps technology complies with the all-electric pathway of the Specialized Stretch Energy Code. They bring high efficiency, GSHP COP typically ~4.0, ASHP COP typically ~3.0 (lower with low winter temperatures). • Heat pumps extract heat from a source and reject it to another. The source can be water, ambient air or the ground. • Full Geothermal Option ○ Ground loop to water-to-water heat pump to 4-pipe system, serving terminal units within the building and rooftop units. Rooftop units consist of single-zone units and DOAS (ventilation). ○ Backup electric boiler for emergency use. ○ Indoor water to water heat pump have typical life span of 20 years. ○ Less equipment on roof, which would support more potential PV system capacity. ○ More mechanical room space required. • Hybrid Option ○ Adding rooftop AtWHP to supplement ○ Indoor water to water heat pump have typical life span of 20 years. ○ Rooftop units are exposed to elements and have typical life span of 15 years. ○ Defrost cycle in the winter which can take away heating capacity that serves the school when it needs to de-ice the coils. ○ More complex controls with 2 systems versus 1 system. ○ Mechanical room space inside the building and roof space required. • Full AtWHP ○ Heat pumps on roof and serving 4-pipe hydronic service to the building ○ Most simple controls out of the 3 options. ○ The heat pumps are all on the roof, and least amount of mechanical room space within building required of the 3 options. • Phasing ○ Phase 1: Renovate the existing Gym & Pool Wing, Add new wing off the North side of the school. Demo a portion of the existing school ○ Phase 2: New build the rest of the school. Demo a portion of the existing school. ○ Phase 3: Complete demo of the existing school • Full GSHP and hybrid option that uses non-deed restricted land will required a temporary heating and cooling system until the end of Phase 3. The hybrid option that uses the deed restricted land and the full AtWHP option can be completed after Phase 2 and would not require a temporary system . • If we are to use the deed-restricted property to install geothermal bore wells, that would require an Article 97 permitting process, 2/3 vote approval from legislation and additional permitting-related costs. Article 97 costs are not included in the current LCCA. • Any temporary mechanical systems will also require a temporary electrical system, which is an additional cost. • The Medford Advisory Committee voiced their preference for the AtWHP. Mechanical System Selection Discussion • Comment supporting Hybrid System. Upfront initial costs for geothermal is significant. • Comment supporting AtWHP System. Ken Lord advised current system is not complex, it is fragile. Concerned about complexity of Option 2 (AtWHP and GSHP) - add unnecessary complexity long term. Complex site and complex phasing. Do not think it's worth it, AtWHP also has lowest initial cost. • Question if Option 3 harder to get to Net Zero? The design team advised it is not a huge difference. It will require more PV because the system is less efficient. • Question if the heat pump units need to be strategically placed or do they need to be located near the rooms or locations they will serve. The design team advised it needs to be placed relatively close to the zone they are serving and/or the mechanical room (depending on the unit). The design team advised it is likely that there is not enough real estate on roof, regardless of mechanical system, will need high canopy PV. • Comment regarding the article 97 permitting process, and knowing that it's not even a guarantee is hard to recommend, and don't really need more complexity or cost on this project right now, the full air to water system is also complete in phase 2, and less complex to maintain. The design team advised AtW system would be complete at Phase 2 in comparison to the other systems. All Heat Pump systems have complex controls, however the AtWHP system is typically simpler to operate than the geothermal options. • Comment supporting Option 3. Less complex for facilities staff. • Question if dehumidification can be challenging. What considerations for dehumidification for comfort and indoor air quality. The design team advised that will be done through the rooftop units for all systems. • Comment supporting Option 3, however it has the lowest utility incentive (would not be maxing out). • Comment that the City of Medford has made commitment to Net Zero, but need to look at reality. It feels like a good environmental answer to say AtWHP, but it is solid and financially makes sense. More Solar and carports is okay. • Question if higher canopies have more maintenance and affect efficiency, and impact on mechanical system. The design team advised Manufacturer provides

		clearances from heat pumps and side access - it is not typically an issue, but it is coordinated during design with the high canopy systems. • **The SBC Chair asked for a tentative recommendation of the mechanical system selection by the advisory team for the SBC. Tentative recommendation for Option 3 (100% AtWHP): Unanimous vote from Medford Sustainability & MEP Systems Advisory Team.**
06.05	SMMA	**Preliminary Solar PV Analysis** • Visual examples (photos) of roof and parking structure Solar PV systems were provided, for low roof mounted and high canopy Solar PV systems, as well as parking space only canopy and long span parking Solar PV systems. • An early assessment of the Solar PV capacity was conducted, in partnership with the Solar PV consultant, Solar Design Associates, showing that the site and building facility may be able to provide enough area/capacity for a large Solar PV system that would get close to achieve a Net Zero Energy (NZE) Facility. The preliminary assessment demonstrated that a hybrid of low roof mounted/high canopy Solar PV system and parking space cover/longs span Solar PV parking canopies would be required to attain the NZE goal, with an estimated 50% NZE provided by the Solar PV roof system and 50% NZE by the Solar PV parking system. • The 100% Net Zero Energy Site Capacity would require a 6 MWh System. • A PPA (Power Purchase Agreement) would entail design, procurement, installation, maintenance, replacement, and utility coordination would be by a third-party. PPA contract with large system would likely include a battery system. This is financially beneficial as there are no upfront costs for the Owner, with the exception of Solar PV readiness at the roof and parking and electrical utility infrastructure. However, the PPA third-party owns and benefits from all energy production grants/incentives, peak load reductions etc. RECs rights may be negotiated in the contract. The building owner would benefit from a reduction on the utility $/kWh (~$0.02-0.05/kWh or estimated $121,000-302,608). For LEEDv4, the renewable energy credit requires the Owner to own the RECs and full commissioning of the PV systems (which have been challenging with PPAs in previous projects). • A School/City Owned Solar PV system would entail that Medford would own the design, procurement, Installation, Maintenance, Replacement, infrastructure and coordination with utility company and may include a battery storage system. The Owner would receive the benefits including grants/incentives, peak load reductions, and renewable energy certificates (RECs). For LEEDv4, the renewable energy credit requires commissioning included in the scope of the project to be able to claim all associated energy points. • A Roof Solar PV System (assuming 70% high-canopy and 30% low-ballasted system) capacity is approximately 50% NZE and produces approximately 2,991,000 kWh of total annual energy production and estimated total cost of $19,677,000. This is more than the PSR priced PV1 alternate (estimated at $3,274,000), which accounted for about 20% of NZE. • A Parking Solar PV System (assuming 70% high-canopy and 30% low-ballasted system) capacity is approximately 50% NZE and produces approximately 2,681,777 kWh of total annual energy production and estimated total cost of $20,979,000. The PSR PV2 alternate estimated $28, 792,000 included the parking canopy structure only, assuming a 100% NZE PPA. • The Roof and Parking Solar PV System would produce a total of 5,672,777 kWh and estimated cost of ~$40,656,000 for a 100% NZE, and the battery Storage/Micro-grid has an estimated cost of $4,900,000, for a total of $45,456,000. • The estimated costs of panel and structure are based on most recent high school project. This cost may differs from the total costs in the PSR estimate for PV1, PV2 and PV3. Solar PV Discussion: • Comment for the design team to present installed system size, in terms of kW. On a commercial system, it is good to look at PPA and ownership. Operational costs are typically baked into cost of PPA. The design team advised the preliminary analysis includes cost for low-ballasted roof is typically $3.00/Watt. High-roof and parking canopy is approximately $7.00/W. • Question of how much of PV cost is carried in current estimate? The design team advised the current cost estimate accounts for a PPA provided PV array on the roof of the building only. • Question if the pool and gym roof been evaluated for PV & HVAC equipment. The design team advised the pool/gym will be getting upgrades, however, we will confirm if the structure upgrade was included in the budget. • Question regarding where these prices as standalone projects or part of a new building construction project? Alicia Hunt advised they have had very good rates when we included solar as an ad-alt to new building projects (police, library) and offered to provide the pricing that we would be offered through Power Options for solar. Alicia H. advised that those of us that buy (and sell) these systems understand the KW #s, and have a maintenance contract for our other arrays. The design team advised the costs were from a recent commercial construction project.
06.06	SMMA	**Healthy Materials** • Topic to be discussed on October 1st, 2026
06.07	SMMA	**Water Stewardship** • Topic to be discussed on October 1st, 2026
06.08	SMMA	**Embodied Carbon & Mass Timber** • Topic to be discussed on October 1st, 2026
06.10	SMMA	**Next Steps** • Next Advisory Team meeting October 1st, 2026: ○ Continue presentation of topics from this meeting. ○ Review/discuss recommendations to the SBC on October 6th on the following: ▪ Solar PV and Battery Storage Extent and Approach ▪ All-Electric Heating/Cooling System Options for SD LCCA ▪ Mass Timber Approach to Addition Structure • SBC Meeting October 6th, 2026