Lexington High School

School Building Committee

Agenda

1. Call to Order
2. Vote on Previous Meeting Minutes 12:00 – 12:05
3. Geothermal Update 12:05 – 12:20
4. Life Cycle Cost Analysis (LCCA) Update 12:20 – 12:40
5. Solar PV Update 12:40 – 1:00
6. Student Enrollment Considerations 1:00 – 1:20
7. Criteria Matrix Evaluation 1:20 – 1:35
8. Public Comment 1:35 – 1:45
9. Reflections & Action Items 1:45 – 2:00
10. Adjourn 2:00

Geothermal Update

Geothermal Update

Bedrock at 70 ft

Unstable borehole conditions at 190 ft – Bloody Bluff

Low Thermal Conductivity: 1.3 Btu/hr-ft-°F

Next Steps

- Additional test boreholes proposed
  to confirm bedrock conditions and Thermal Conductivity
- Refine system sizing
  - Hourly Heating/Cooling Load Calculations – Bloom
  - GSHE borefield modeling to assess sizing

BOREHOLE VERTICAL PIPING

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Life Cycle Cost Analysis Update

Life Cycle Cost Analysis Update

PSR Adjusted LCCA

- Incremental Costs and Paybacks
- Summary HVAC Systems Costs and [Construction] Incentives
- 75-yr. LCCA PSR Update
- Peak Load Analysis – In Progress
- Planning a 2nd integrated meeting with Eversource:
  - Electrical Infrastructure Planning
  - Solar PV/Interconnection
  - Demand Response
  - EV Charging Stations

Summary Estimated Construction MassSave and IRA Incentives

Incentive Program	Incentives	
	GSHP	ASHP
Mass Save		
NZE - <25EUI – Path 1	$950,000	$950,000
Post occupancy verification	$712,500	$712,500
Heat Pump Systems	$7,200,000	$5,600,000
Inflation Reduction Act		
Ground Source Heat Pumps	$18,090,000	N/A
Total Incentives	**$26,952,500**	**$7,262,500**

Summary HVAC Systems Costs & Incentives

(MassSave and IRA – Construction Incentives)

HVAC System Type	HVAC System – Total PSR Estimated Costs	Incentives (MassSave/IRA)	Total HVAC System Costs with Incentives	HVAC System Cost Savings	
Air Source HP	$47,333,143	**$7,262,500**	**$40,070,643**		
Ground Source HP	$63,349,619	**$26,952,500**	**$36,397,119**	($3,673,524)	5.9%

Notes:

1. System Costs($) based on the PSR Cost Estimates. Total system costs includes all HVAC equipment. GSHP System Costs includes bores/wells/casings for the GSHP system.
2. Costs do not include the existing site fields re-construction.
3. Incentives include MassSave and IRA incentives listed in Table 2 below.

Summary Incremental Costs & Paybacks
(Not Including Solar PV System)

PSR Incremental Cost & Payback Summary Relative to PSR HVAC Systems Code Baseline Costs				
HVAC System	***Incremental Costs***	***Estimated Annual Energy Costs Savings***	***Estimated Incentives MassSave + IRA***	***Estimated Payback***
Air Source HP	*$3,951,639*	*$453,333*	*$7,262,500*	*0* yrs
Ground Source HP	*$19,967,115*	*$458,654*	*$26,952,500*	*0* yrs

Notes:
1. Energy Savings: based on total annual kWh savings, using the average 2023-24 $0.24/kWh (utility bills). Peak demand savings not included (in progress)
2. Incremental Costs are based on the PSR Cost Estimates and include materials and labors and are based on a per cost comparison to the analysis system baseline (ASHRAE 90.1-2019 App G).
3. GSHP payback without the IRA incentives is estimated at 15-24 yrs. Please note that the well testing results and system efficiency in upcoming LCCA updates will contribute to a payback reduction

Life Cycle Cost Analysis Update

Preliminary PSR LCCA Analysis Summary

Estimated 75-year LCCA Costs as Net Present Value

HVAC System	Installation Cost	Replacement Cost	Maintenance Cost	Energy Cost	Total 75-year LCCA	Total 75-year LCCA w/ Incentives	GHG Emissions Reduction
Air Source HP	$47,333,143	$34,622,128	$4,306,765	$12,133,065	$98,396,000	**$91,133,500**	51.0%
Ground Source HP	$63,349,619	$19,078,241	$4,306,765	$11,974,999	$98,710,000	**$71,756,500**	51.3%

Notes:

1. Installation costs are based on the PSR project cost estimates, as well as at each design phase.
2. Replacement costs are specific to each system, based on ASHRAE useful life data and using unit costs for equipment and labor, brought forward as Net Present Value (NPV) costs.
3. Maintenance costs are estimated to include third-party service to systems, but in-house routine maintenance.
4. Energy costs are based on energy modeling analysis, using the 2023-24 Lexington utility bills, with an average [blended] annual $0.24/kWh (baseline $1.40/Therm), with a 3% cost escalation rate. The energy costs do not yet include peak load reductions expected out of the project Solar PV/Battery Storage. Peak demand costs represent approximately 50% of Lexington's annual utility costs. It is expected that the battery storage peak load reduction will benefit the energy costs.
5. Total 75 yr. LCCA Cost is the sum of Installation, Replacement, Maintenance and Energy costs. Present Value modeled on a 75-year lifecycle cost, 3% cost depreciation.
6. Incentives include MassSave NZE Path 1, Heat Pumps Incentives, POE incentives and IRA (for Geo-thermal system) . Incentives do not include the potential annual Renewable Energy Certificate (REC) for the GSHP. RECs calculation are in progress.
7. Costs of the existing field re-construction is not included.

Life Cycle Cost Analysis Update

Post-Occupancy Incentives

PRELIMINARY LCCA Peak Load Analysis – in progress:

- Update to SDA Solar PV monthly peak harvest output analysis
- Energy Model: Monthly estimated energy model peak load demand
- Utility Programs - Demand Response:
  - Connected Solutions: Summer months - max 150% of your peak from storage
  - HVAC BMS virtual program – preset HVAC systems' controls reductions
  - To be further discussed with FM team and Eversource

Additional LCCA Annual Savings:

- GSHP - Alternative Energy Certificates (AEC) - RECs
- Solar PV - SMART Program – TBD

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Solar PV Update

Estimated Annual Building Energy Use:

3,300,000 – 3,500,000 kWh

Based on **EUI**

25

KBtu/SF/Yr.

Solar PV Analysis Caveats:

- Sizing and quantities are PRELIMINARY and subject to change
- Include a 10% margin of error
- Preliminary HVAC layouts: subject to change with impact available roof areas and final PV layout: location, clearances, roof screens, etc.

NET ZERO

Based on **EUI**

25

KBtu/SF/Yr.

3,500,000 kWh

Project Scope $

NET POSITIVE

Based on **EUI**

25

KBtu/SF/Yr.

+

50-250 EV Stations

Up to 4,000,000 kWh

Additional Costs $$$

Estimated Solar PV System Site Sizing and Annual Production			
C.5b Bloom / GSHP	**Estimated Total Annual Production (kWh)****	***% Additional Production*** *(over 3,500,000 kWh)*	***Estimated Incremental Costs****
NET ZERO [Roof/Parking Spaces Only]	**3,694,383**	**6%**	**In Progress**
NET POSITIVE [Roof/Partial Pkg. Longspan Canopies]	4,656,589	33%	In Progress

***Notes:**

1. The Estimated Total Annual Production values are PRELIMINARY and represent an optimal yield of the modeled system. Values are subject to change as the system's design (layout, stringing, shading, roof equipment screens, etc.) advances that will impact the final Solar PV sizing, a 10% margin of error has to be accounted for.

2. The assessments take into the maximum total roof areas allocated for Solar PV within the preliminary HVAC roof equipment assessments. They are subject to reduction/adjustments in area available, pending HVAC design layouts/walkways, paths, and setbacks, and roof screens. They take into account the 10-15' high shading from the HVAC equipment areas, shading from the buildings on the canopies, and canopy-to-canopy shading.

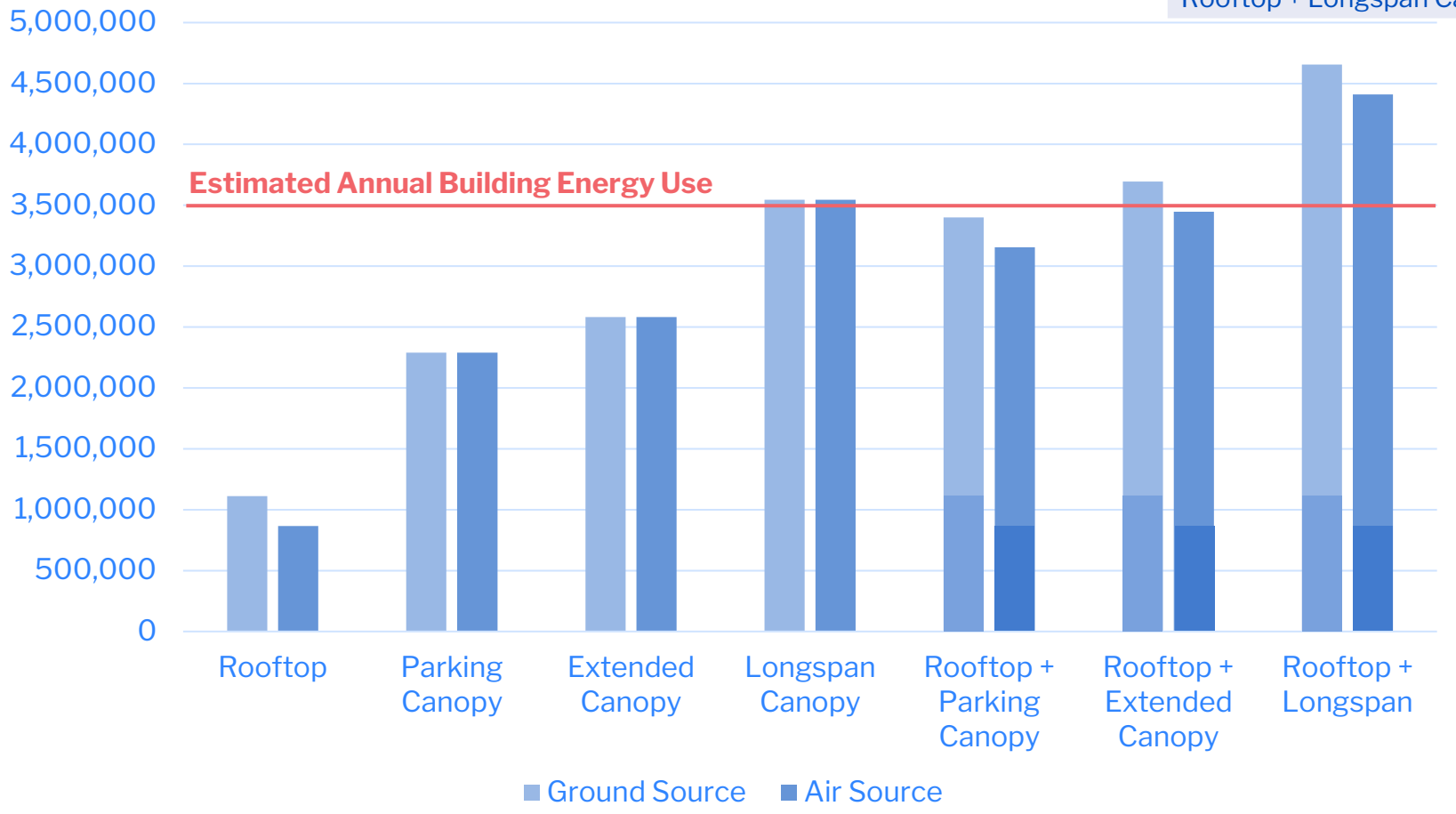
3. Incremental Costs for PV only. Costs do not include additional Lighting, fire protection system, etc.

4.ASHP systems would reduce the roof Solar PV capacity by 30%. The total roof/expanded parking option would result in no incremental production over the NZE 3,500,000 kWh goal. The roof and longspan parking would result in 28% additional production.

BLOOM

Estimated Total Annual Production (kWh)		
	Ground Source	Air Source
Rooftop	1,112,2234	865,063
Parking Canopy	2,289,116	2,289,116
Extended Parking Canopy	2,582,159	2,582,159
Longspan Canopy	3,544,365	3,544,365
Rooftop + Parking Canopy	3,401,340	3,154,179
Rooftop + Extended Canopy	3,694,383	3,447,222
Rooftop + Longspan Canopy	4,656,589	4,409,428

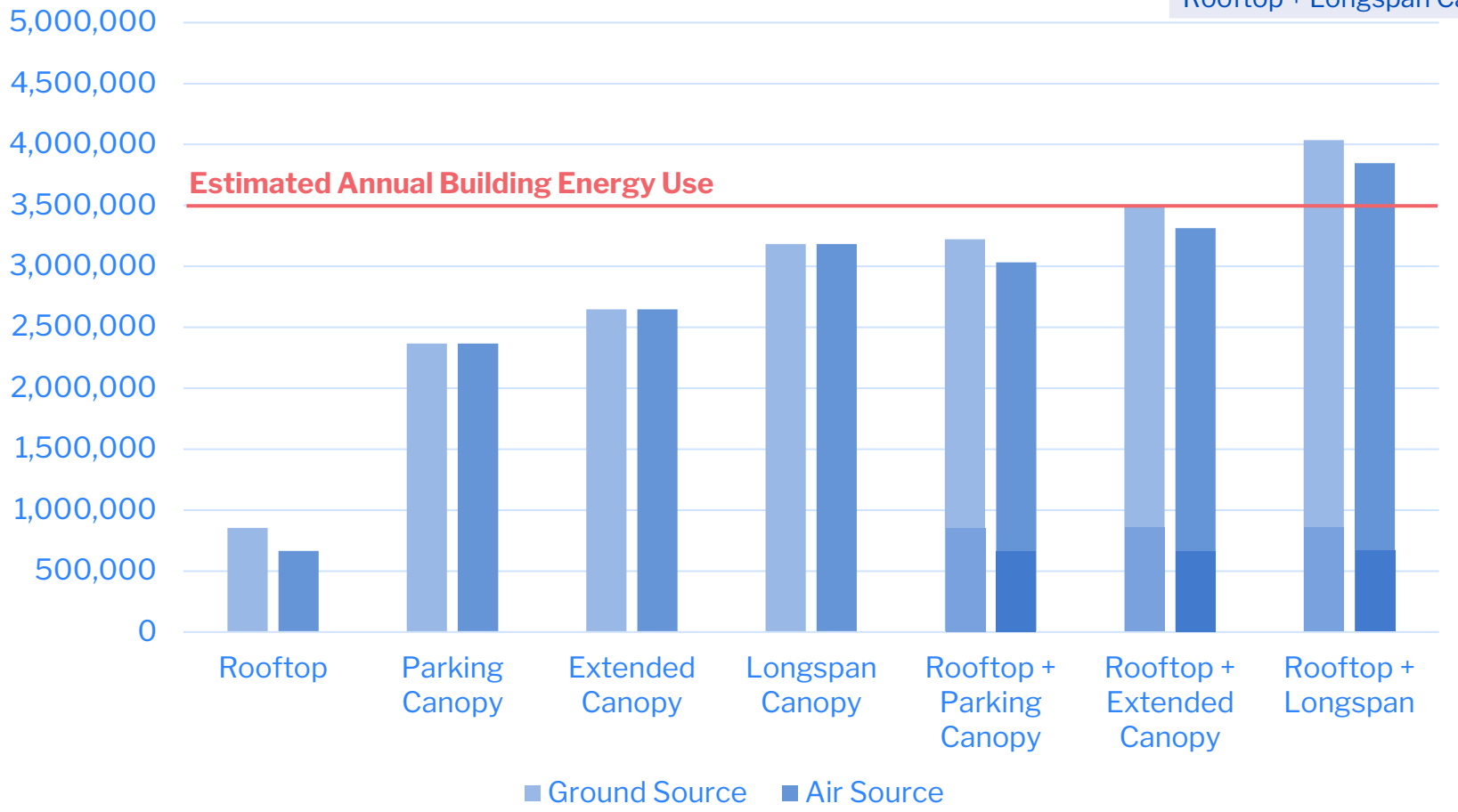
Estimated Total Annual Production (kWh)



WEAVE

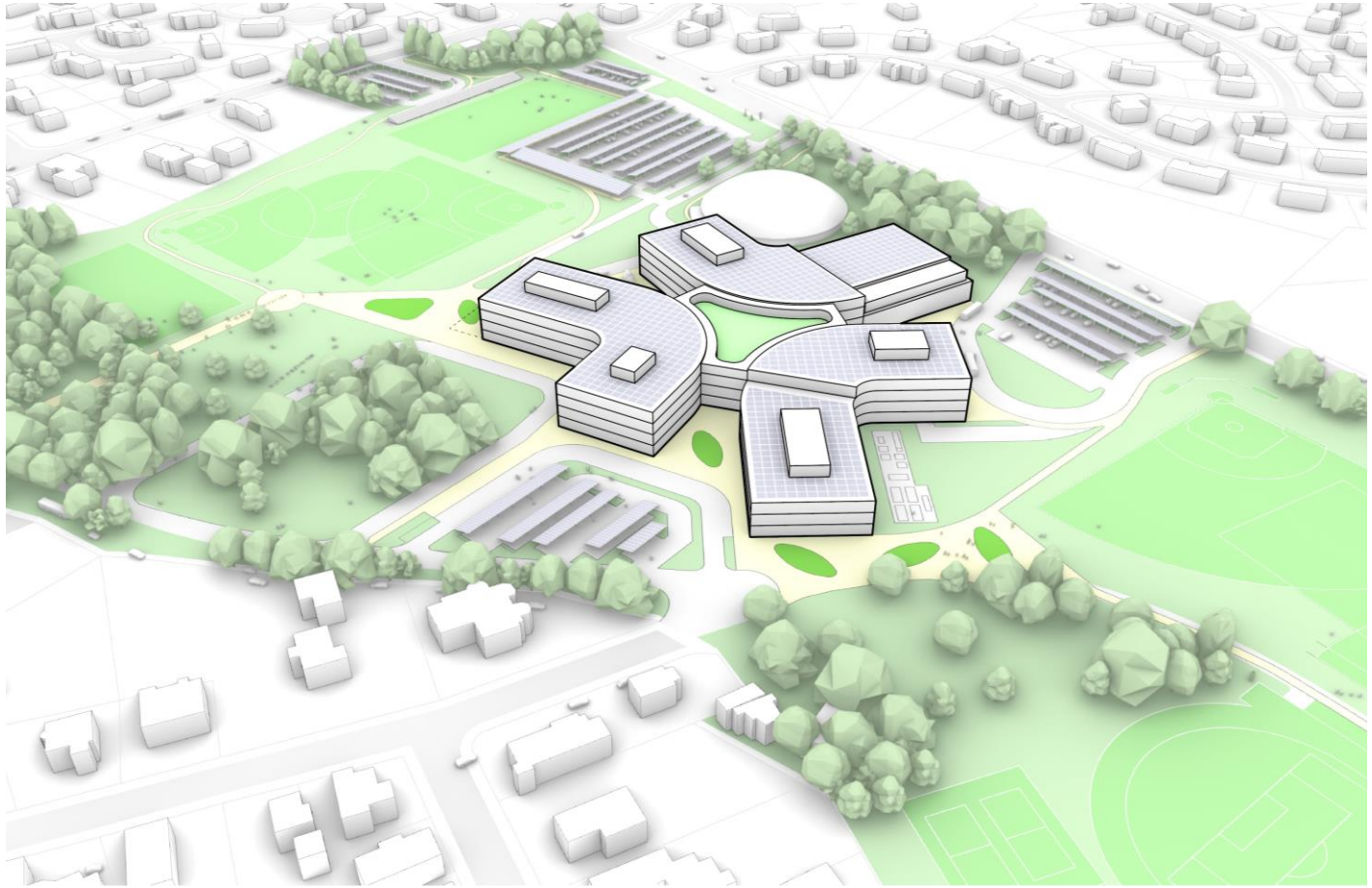
Estimated Total Annual Production (kWh)

Estimated Total Annual Production (kWh)		
	Ground Source	**Air Source**
Rooftop	855,006	665,005
Parking Canopy	2,367,851	2,367,851
Extended Parking Canopy	2,648,128	2,648,128
Longspan Canopy	3,182,219	3,182,219
Rooftop + Parking Canopy	3,222,857	3,032,855
Rooftop + Extended Canopy	3,503,134	3,313,132
Rooftop + Longspan Canopy	4,037,225	3,847,223

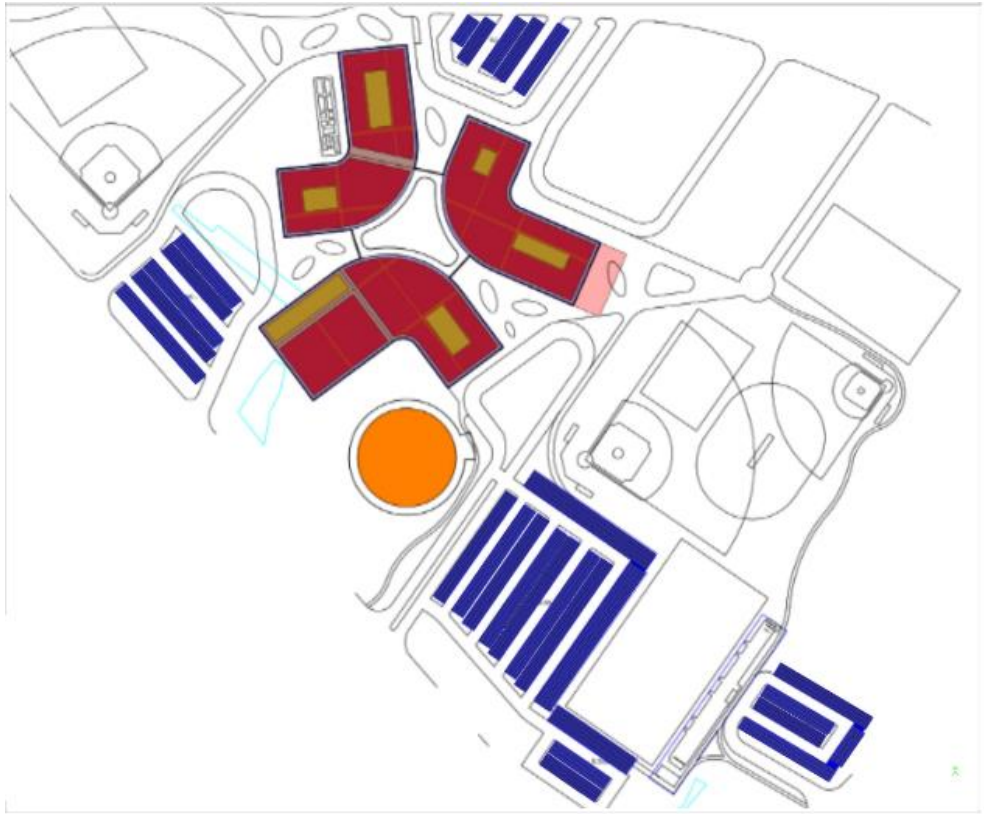


Solar PV Update / C.5b Bloom – Expanded Parking Canopy

C5.b Bloom *Roof & Parking Spaces Only*	
Estimated Annual Total Production (kWh)	3,694,383

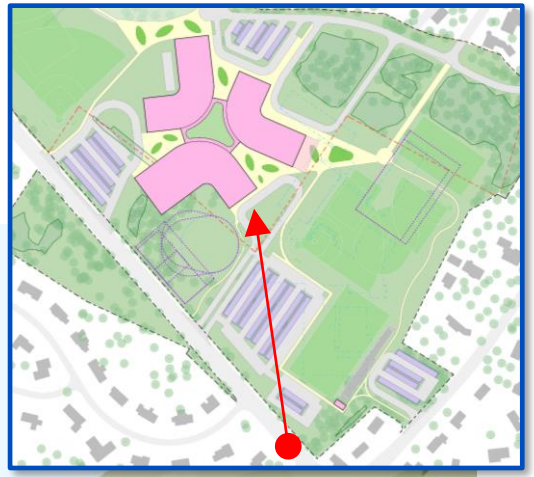


View of Roof + Parking Scenario

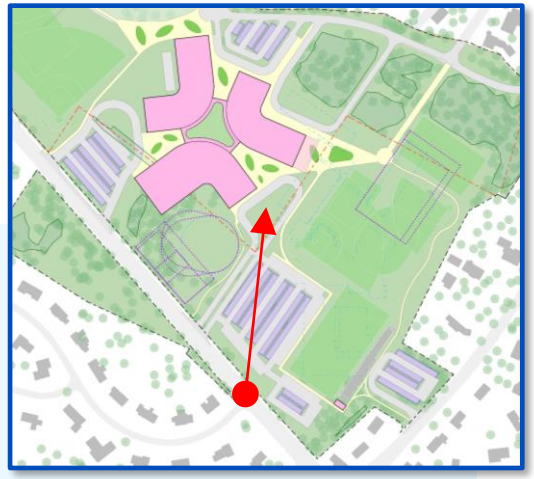


Solar Design Associates: Rooftop Solar PV Layout (Expended Parking Canopy)

Solar PV Update / C.5b Bloom



Solar PV Update / C.5b Bloom



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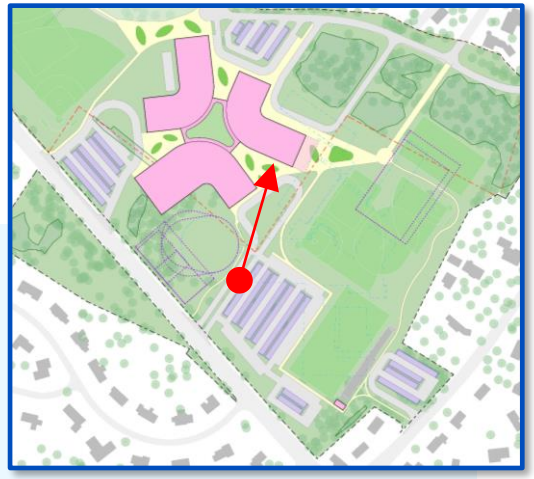
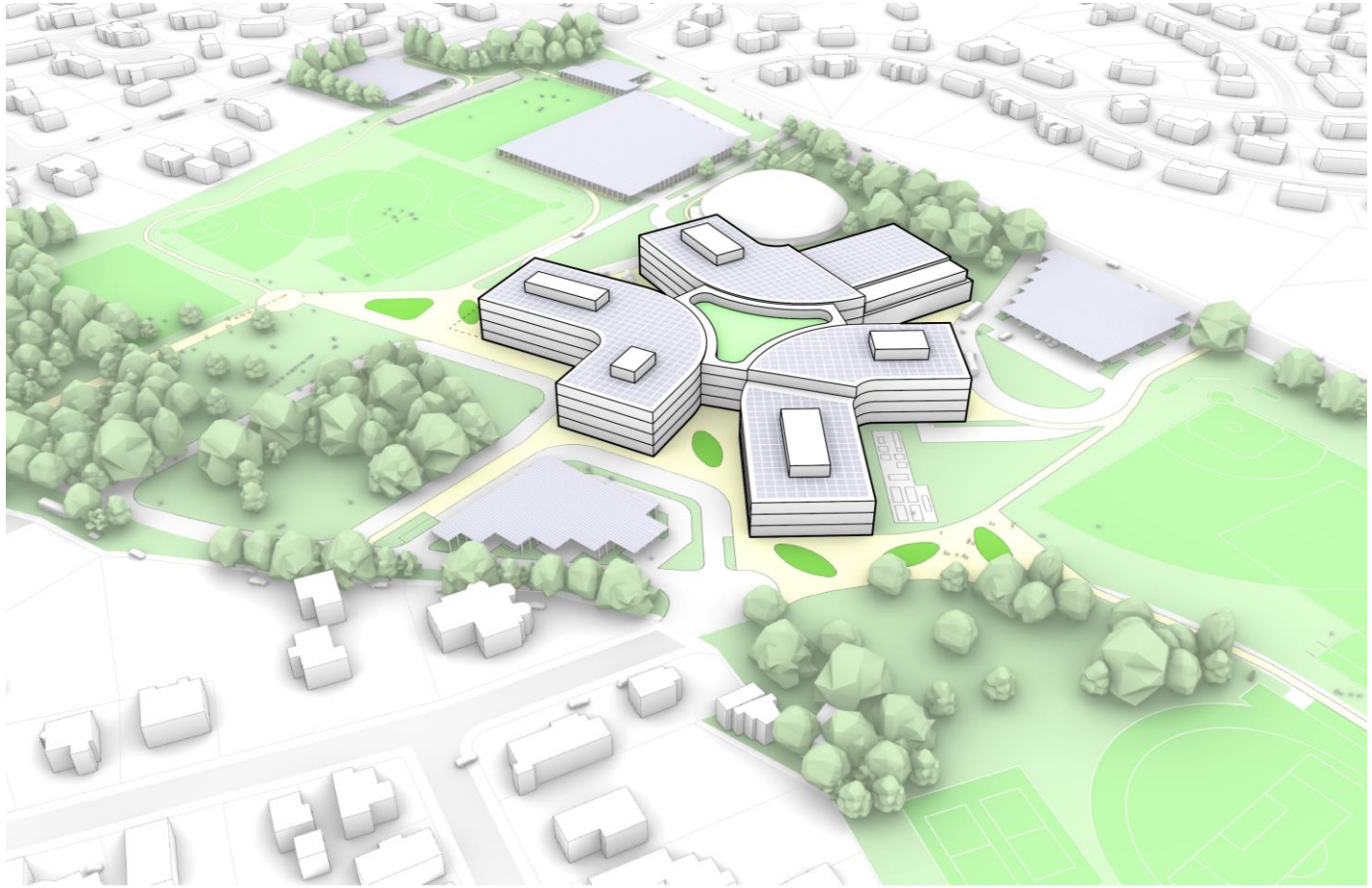


Solar PV Update / C.5b Bloom

Solar PV Update / C.5b Bloom - Full Parking Canopy

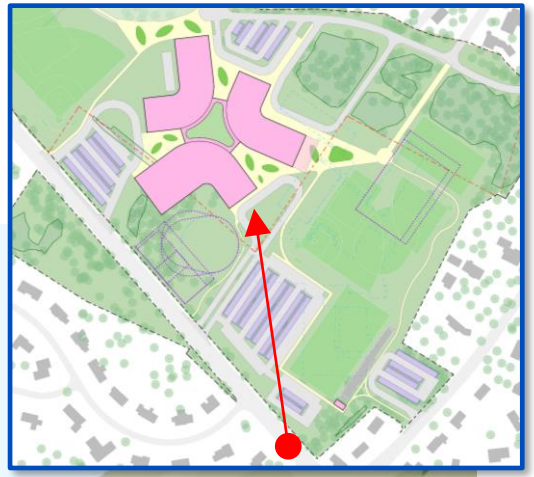
C5.b Bloom *Roof & Full Longspan Parking Canopy*	
Estimated Annual Total Production (kWh)	4,656,589

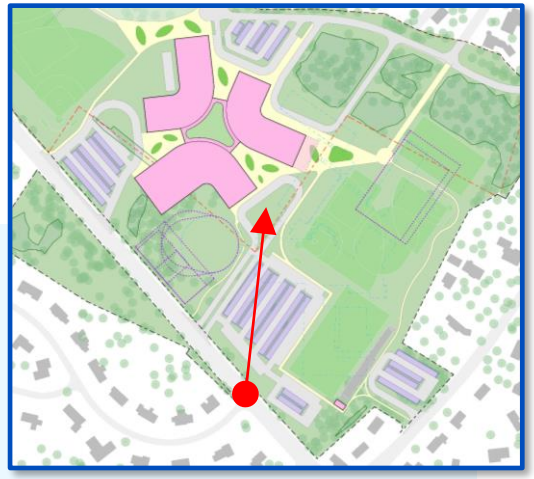


View of Roof + Parking Scenario

Solar Design Associates: Rooftop Solar PV Layout (Expended Parking Canopy)

Solar PV Update / C.5b Bloom – Long Span PV Study





Solar PV Update / C.5b Bloom – Long Span PV Study

Updated Solar PV Assessments - In Progress:

- Show full parking + roof capacity (high canopy)

Solar PV Layout – Long span full covered Parking Canopy

Assess Future EV readiness installation – In Progress:

- 10%, 20%, 30%, 40% and 50% Thresholds
- Incremental Solar PV, Costs
- Impact on Infrastructure

Solar PV Layout - Expanded Parking Canopy

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Student Enrollment Considerations

Student Enrollment Considerations

Increase #of Students per Class and Classroom Utilization Rates		
# of Students per Class	Classroom Utilization Rate	Total # of Students
23	**85%**	**2395**
24	85%	2480
25	85%	2546
25	90%	2695

Increased Class Size: This would be across the board except in rooms that have identified capacities. E.g. special education, technology labs where safety is a concern; science lecture/labs. In each of these cases, additional rooms would need to be added.

Utilization: It is industry standard to program a High School at 85%. One cannot simply translate an increased utilization rate to an increased number of students. Utilization is the percentage of time a room is used. The higher the rate, the reduced opportunity for students to be accepted into the desired classes. The higher the rate the more difficult it is for Administration to schedule the spaces.

Student Enrollment Considerations

Plus Expansion into Central Office Space		
# of Students per Class	Classroom Utilization Rate	Total # of Students
24	85%	244

Central Office Retrofit: At this level of analysis this space has been calculated as general education classrooms only, although some of that space may need to be SPED or Admin space.

Plus Additional Expansion		
# of Students per Class	Classroom Utilization Rate	Total # of Students
24	85%	256

Expansion Space: At this level of analysis this space has been calculated as general education classrooms only, although some of that space will most likely need to include SPED classrooms, Additional Dining and Media Center capacity and Admin space.

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Criteria Matrix Evaluation

Criteria Matrix Evaluation

	In Place			On Fields		
	B.1 Quad	B.4 Figure Eight	**D.2 Weave**	C.1d Branch	C.2b Braid	**C.5b Bloom**
Project Cost	$699 Million	$701 Million	$720 Million	$646 Million	$645 Million	$648 Million
Modulars	32	42	48	0	0	0
Construction Duration	6	6.25	6.5	4.5	4.5	4.5
Displacement of Fields (assumes ground source)	Fair	Fair	Fair	Poor	Poor	Fair
Disruption to Students	Poor	Poor	Fair	Good	Good	Good
Academic Adjacencies	Fair	Fair	Good	Good	Good	Good
Connections to Outdoors	Fair	Fair	Fair	Good	Good	Good
Organizational Flexibility	Fair	Fair	Good	Good	Good	Good
Site Circulation	Fair	Fair	Fair	Fair	Fair	Good
Future Expansion	Fair	Fair	Good	Good	Good	Good
Facilitates Inclusive Interactions	Fair	Fair	Good	Good	Good	Good
Civic Presence	Fair	Fair	Fair	Fair	Good	Good
MEP Systems Design Efficiency	Poor	Poor	Good	Good	Good	Good
Efficiency of Design	Poor	Poor	Good	Good	Good	Good
Article 97 Implications	Fair	Fair	Good	Poor	Poor	Poor
Project Complexity	Poor	Poor	Fair	Good	Good	Good
Delay Potential	Most Likely	Most Likely	Likely	Unlikely	Unlikely	Unlikely
Need for Specialty Swing Space	Fair	Poor	Good	Good	Good	Good

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Thank you