Greater VICTORIA School District

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Office of the Secretary-Treasurer

Kim Morris - Secretary Treasurer

TO: **Operations Policy & Planning Committee of the Whole**

FROM: **Kim Morris**

RE: **Net Zero Cedar Hill Middle School Replacement Options UPDATED**

DATE: **December 6, 2021**

Background

At its September 27, 2021 Regular Open Board meeting, the Board made the following motion:

> *Be it resolved that the Board of Education of School District No. 61 (Greater Victoria) direct the superintendent to direct staff to determine the cost of incorporating net zero into the design of new Cedar Hill Middle School;*
> *AND FURTHER*
> *That staff report the cost, including business case, back to the Board by November 2021 for Board approval to consider the funds for the net zero design.*

A net zero building is an energy efficient building which only uses as much energy as it can produce from on-site renewable energy on an annual basis. The design strategy is first-and-foremost to reduce the energy consumption of the building through building design.

This includes orientation of the building, efficient building form, enhanced envelope design (insulation, reduced thermal bridging, air/vapour barrier system design, glazing, and sunshades), the use of energy efficient mechanical and electrical systems, and energy saving fixtures and appliances.

The second major strategy for the building is to produce any of its remaining energy needs through on-site renewable energy and/or efficient sources. Solar, including photo-voltaic (PV) systems, is the primary viable means of doing this.

In support of developing the Project Definition Report for Cedar Hill a workshop was conducted to identify measures that would optimize the design of the build both in terms of capital costs and energy reductions. The primary goal was to design a school that could generate as much renewable energy on site as it consumed over a typical year – that is a net zero energy (NZE) building. In order to meet the goal of a net zero design in the most cost effective manner, potential energy saving measures were analyzed both in terms of site energy savings and relative value.

The new middle school energy base design for Cedar Hill met or exceeded the requirements of the BC Building code. From this initial base design, three bundle options of energy efficient measures were explored.

Bundle 1: Positive Net Present Value (simply referred to as NPV bundle)

Positive NPV - the projected earnings generated by a project or investment—in present dollars—exceeds the anticipated costs, also in present dollars. It is assumed that an investment with a positive NPV will be profitable. The bundle was configured such that each measure's NPV was positive.

Bundle 1 most notably does NOT include a PV solar array and focuses on reduced capital costs and utility bills primarily by:

- Replacing the base 65T air source heat pump (ASHP) with a 30T ground source heat pump (GSHP)
- Reducing floor insulation from 3 inches (R-15) to 2 inches (R-10) as a cost saving measure.

A horizontal geothermal system was assumed due to bedrock noted in the preliminary geotechnical report. A preliminary site plan and further geotechnical investigation are required to confirm that adding more ground source heat pumps is viable.

The building's main energy source would be ground source heat pump with backup gas boiler.

Bundle 2: Net Zero Ready (NZER)

The Net Zero Ready (NZER) building is ready and able to achieve net zero some time in the future. This bundle allows for other options to be installed or used in the future (i.e. solar panels) when regulatory issues have been resolved and renewable energies become more affordable.

The bundle was configured such that each measure's NPV was better (i.e., higher) than that of a roof-mounted PV system, when normalized for the relative amount of energy the measures saved, or for the PV, that it produced. It included:

- Replacing the 65T ASHP with both a 30T GSHP and a 30T ASHP
- Displacement ventilation in the classrooms
- Lowering the leaving water temperature to 110°F for both heat pump systems
- Variable volume shop dust collector.

IMPORTANT: Bundle 2 can accommodate the addition of a 100kW PV solar array. The 100kW PV solar array falls short of the generation required to meet a net zero energy (NZE) building but falls within BC Hydro's current regulatory parameters.

The building's main energy sources would be air source heat pump and ground source heat pump with a backup gas boiler.

Bundle 3 NZER with 272kW PV Solar Array

While NZER Bundle 2 allows for further PV panels to be added at a later date and is achievable within the design and build of the new school with further funding from the Greater Victoria School District. A net zero school would include the full PV system to be added in the present construction phase. Adding enough rooftop PV to offset the building's equivalent annual energy requirements is achievable with a larger 272kW photovoltaic system at an estimated cost of nearly $1.1M. Currently BC Hydro's net metering program only allows for 100kW systems. Until BC Hydro lifts this cap, the new Cedar Hill Middle School will not be truly net zero using PV systems. NZER with 272kW PV Solar Array would require alternate types of on site energy production under current BC Hydro Net Metering Service constraints.

The building's main energy sources would be air source heat pump and ground source heat pump with a backup gas boiler.

Table 1 outlines the bundle information identified to achieve optimal energy performance.

Table 1 – Information and Costs Associated with Net Zero Ready and Net Zero Builds

Bundle #	Cost Explanation	Annual Energy Costs	CO_2 Emissions (tonnes)	Net Annual Energy Use (ekWh/m²)	Capital Costs x 1	Notes
Bundle 1 Positive Net Present Value	($386,240) NPV Bundle Cost **Total = ($386,240)**	$37,910	26.1	66.3	**($386,240)**	-Less utility costs than base -Less Capital Costs due to replacing the base65T ASHP with 30TGSHP -No PV in this option
Bundle 2 Net Zero Energy Ready – NZER building with 100kW Solar Array	$118,375 Cost of energy design $300,000 – 100kW PV Cost $100,000 – PV Structural Costs **Total = $538,375**	$27,120	10.4	33	**$538,375**	-Higher Capital Costs -Less Energy consumption -Longer payback -Smaller footprint – less GHG Emission
Bundle 3 NZER with 272kW PV Solar Array	$118,375 Cost of energy design $816,000 – 272kW PV Cost $272,000 – PV Structural Costs **Total = $1,206,375**	$9,900 If Net Metering applied to the full 272kW PV System	8.3	0	**$1,206,375**	Annual Net Power Consumption = Annual Net Power Generation *BC Hydro's Net Metering Service has regulatory cap on PV arrays over 100kW*

Note – All costs are from 2020. Prices may increase.

At the estimated energy use requirements, an appropriately sized rooftop PV system should be able to produce enough energy to provide for a net zero building. However BC Hydro currently has a 100kW restriction on their net metering service. Furthermore, the school district could allocate the money for the Photovoltaic system ($1.1M) to decrease greenhouse gas emissions in other schools throughout the school district. Table 2 suggests heating plant upgrades that would not only help the school district move forward on their commitment to climate change but would assist with replacement of aging infrastructure, while having an equitable positive impact for more students to improve indoor environmental quality and decrease the school district's maintenance costs, utility costs, GHG emissions and carbon offset costs.

Table 2 – Suggested Heating Plant Upgrades

Building	Type of Upgrade	Natural Gas Savings (GJ / year)	Electricity Savings (kWh / year)	Capital Cost	Net Energy Cost Savings	Available Rebate	NPV (25,5%)				GHG Savings per year	NPV (Cost) per tCO2e saved	Current Boiler end of life
							Net Capital Costs	Utilities Saviings	Carbon Offsets	Max Total			
Lambrick	Condensing Boiler	686	10,867	$ (575,000)	$ 8,559	TBD	$ (575,000)	$ 120,631	$50,000 min $90,000 max	$ (364,369)	35.3	$ (10,322)	5-10 yrs
	ASHP + Boiler	1856	(159,133)	$ (1,325,000)	$ 2,018	$ 150,000	$ (1,175,000)	$ 28,439	$128,000 min $231,000 max	$ (915,561)	90.8	$ (10,083)	
Colquitz	Condensing Boiler	299	6,500	$ (550,000)	$ 3,879	TBD	$ (550,000)	$ 54,675	$21,000 min $38,000 max	$ (474,325)	14.6	$ (32,488)	5 yrs
	ASHP + Boiler	813	(75,500)	$ (1,225,000)	$ 243	90,000	$ (1,135,000)	$ 3,426	$54,000 min $100,000 max	$ (1,031,574)	38.5	$ (26,794)	
Eagleview	Condensing Boiler	132	5,667	$ (375,000)	$ 2,022	TBD	$ (375,000)	$ 28,498	$9,500 min $17,000 max	$ (329,502)	6.6	$ (49,925)	5 -10 yrs no backup
	ASHP + Boiler	365	(34,333)	$ (875,000)	$ 61	30,000	$ (845,000)	$ 857	$25,000 min $46,000 max	$ (798,143)	17.8	$ (44,839)	
Strawberry Vale	Condensing Boiler	351	(5,000)	$ (375,000)	$ 3,157	TBD	$ (375,000)	$ 44,494	$24,500 min $44,000 max	$ (286,504)	17	$ (16,853)	10 - 15 yrs
	ASHP + Boiler	726	(50,000)	$ (875,000)	$ 2,144	30,000	$ (845,000)	$ 30,218	$49,000 min $91,000 max	$ (723,783)	35.1	$ (20,621)	
Uplands (estimate)	Condensing Boiler	300	-	$ (350,000)	$ 3,171	TBD	$ (350,000)	$ 44,692	$20,500 min $37,000 max	$ (268,308)	14.5	$ (18,504)	5 yrs
	ASHP + Boiler	750	(35,000)	$ (850,000)	$ 4,056	30,000	$ (820,000)	$ 57,165	$47,000 min $85,000 max	$ (647,835)	33.4	$ (19,396)	
Sundance	Condensing Boiler	132	5,667	$ (375,000)	$ 2,022	TBD	$ (375,000)	$ 28,498	$9,500 min $17,000 max	$ (329,502)	6.6	$ (49,925)	5 -10 yrs
*(copied eagleview)	ASHP + Boiler	365	(34,333)	$ (875,000)	$ 61	30,000	$ (845,000)	$ 857	$25,000 min $46,000 max	$ (798,143)	17.8	$ (44,839)	
Southpark	Condensing Boiler	250	-	$ (450,000)	$ 2,643	TBD	$ (450,000)	$ 37,243	$17,500 min $32,000 max	$ (380,757)	12.5	$ (30,461)	5 yrs
Quadra Repair	ASHP + Boiler	650	(50,000)	(-175,000)	$ 1,340	0	$ (175,000)	$ 18,886	$50,000 min $90,000 max	$ (66,114)	32.4	$ (2,041)	10-15 yrs no backup

Conclusion:

The Board's ability to construct Cedar Hill Middle School to a "net zero now" building is constrained by BC Hydro at this time. Therefore while the Board could invest in the infrastructure to make the building net zero at a future date, the recognition of footprint reduction may not be in the foreseeable future. The school will not be occupied until 2025, so the Board should consider the risk of overbuilding the infrastructure in hopes that BC Hydro's limits will change.

Alternatively, the Board could consider taking the intended net zero now investment and spreading it across various projects in the district to have the same effect while under current BC Hydro constraints.

The Board has the opportunity to invest in carbon neutral capital projects at Cedar Hill Middle School as a stand-alone project, or across multiple projects.

Recommendations:

1. The Greater Victoria School District promote Bundle 2 - Net Zero Energy Ready with a 100kW PV array at a cost of $538,375 for the following reasons:
    - Bundle 3 – NZER with 272kW PV Solar Array is not feasible with BC Hydro's current net metering regulatory constraint of 100kW.
    - Less capital costs than Bundle 3 – NZER with a 272kW PV Solar Array
    - Achievable now without relying on changes from BC Hydro which are not guaranteed.

2. The Greater Victoria School District Board advocate for BC Hydro to lift the 100kW net metering cap by advocating directly with BC Hydro and through BCSTA to BC Hydro, Minister of Education, Minister of Finance, Minister of Environment and Clean BC.

3. Prioritize targeted funds, in excess of the required Bundle 2 NZER with a 100kW PV Solar Array $538,375 capital outlay, on carbon reducing heating plant retrofits that will reduce district carbon immediately, while simultaneously replacing equipment that is nearing end of life. Please refer to Table 2 above. Upgrading Lambrick Park's aging infrastructure would cost $1.3M with an annual carbon savings of 90.8 tonnes. Suggested spending plans could include:

	$2.5M – Estimated Communicated in Public Consultation	**$1.2M-Estimated for Bundle 3**
NZER Cedar Hill with 100kW PV Solar Array	$538,375	$538,375
ASHP + Boiler Lambrick Park	$1,325,000	$1,325,000
Condensing Boiler Colquitz	$550,000	$0
Total	**$2,363,375**	**$1,862,375**

OR

Spend residual Bundle 2 NZER with 100kW PV Solar Array funds on smaller carbon reducing projects throughout the district.

- DDC Upgrades
- Provincially incentivized recommissioning of buildings
- Behavior change initiatives that offer funding of sustainable projects to schools that successfully meet behavior change goals.
- Upgrading roofs throughout the district
- Upgrading portables to air source heat pumps (ASHP). This offers a small reduction in carbon, while also proving a substantial return on investment.

OR

The Greater Victoria School District consider promoting photovoltaic solar energy now, at different sites throughout the school district that would be more suitable and cost effective to a PV solar installation, and would stay within current BC Hydro constraints.

Under current BC Hydro Net Metering Rate structure, PV systems appear to be much more economical in smaller schools that fall under the Small General Service rate structure. Choosing the smaller sites would avoid slipping into minimum charges based on peak winter demand during the summer while generating the most electricity and provide an educational opportunity for more students. Smaller sites to consider are Eagle View Elementary or Northridge Elementary as examples.

Note:

The maximum approved potential project budget is $46M and includes a $3.5M district contribution to bridge the cost difference between the option to replace the school and the option to seismically upgrade the school. The Ministry's approved funding is for a LEED Gold equivalent school and a Net Zero Energy Ready building, which does not include the 100kW photo voltaic solar array. Ministry approval is required prior to any material changes to the project's scope, schedule, procurement method, or budget. Additional government approvals will delay the design phase and increase the risk to the completion schedule and budget overall.