

TerraVerde

ENERGY



EVSE, SOLAR PV AND BATTERY ENERGY STORAGE
FEASIBILITY AND COST REVIEW | June 8, 2021

The left side of the slide features a dark, abstract background with green and black geometric shapes and grid patterns. The TerraVerde Energy logo is positioned in the bottom left corner of this section.

PRESENTATION OUTLINE

- Summary of Project Portfolio
- Key Considerations
- Summary of Findings
- Summary of Scenario 1
 - New Meters
 - Existing Meters
- Summary of Scenario 2
 - New Meters
 - Existing Meters
- Summary of Findings and Considerations
- Questions

SUMMARY OF PROJECT PORTFOLIO

School	Designation	Total Approximate Parking Spaces (Google Earth)	Student Enrollment	Scenario 1 Total Chargers	Scenario 2 Total Chargers
Archie Williams (formerly Sir Francis Drake HS)	Comprehensive	150	1269	14	150
Redwood HS	Comprehensive	500	2009	22	250
San Andreas HS	Alternative	40	89	4	12
Tamiscal HS	Alternative	60	142	4	18
Tamalpais HS	Comprehensive	150	1643	18	150
Total			5152	62	580

KEY CONSIDERATIONS

	Considerations
Capital Cost	-Solar PV Installation Costs -Battery Energy Storage System Installation Costs -EVSE Installation Costs -Infrastructure Upgrade Costs -Micro-grid Controller Costs
Equipment Sizing	-During the scenarios with the EVSE connected to the existing meters, the solar PV and battery energy storage systems are sized to the site load post the addition of the EVSE. -During the scenarios with the EVSE connected to new meters, the solar PV and battery energy storage systems are sized to the current site load and interconnected behind existing meters only. -The solar PV systems and battery energy storage systems were sized assuming a conservative position for bond funding requirements, and actual project sizes should be verified prior to a solicitation process.
Equipment Lifetime	-Solar PV system warranties are typically for 25 years, with inverter replacements every 10 years -Battery energy storage system warranties are typically for 15 years -EVSE warranties are typically 5 years
Resiliency	-During the scenarios with the EVSE connected to new meters, in the event of an outage, these meters will not be provided resiliency from the solar PV and battery energy storage system.
EVSE Usage	-Assumes only students and staff will be able to use the chargers -The amount of charge needed per vehicle varies - The number of chargers in use at the same time varies -Includes a percentage of staff and students leaving during lunch and plugging back in upon return to campus -Controls were assumed to allow for active management of the EVSE load, and prevent charging during peak pricing hours
New Meters Versus Existing Meters	-Installing EVSE behind new meters may help address the variability of these loads. -Under the existing meters scenario, the solar PV and battery energy storage systems were sized based on an assumed EVSE consumption profile that may or may not align with the actual consumption profile. -Changes in the actual consumption profile would have an impact on the associated financial

SUMMARY OF FINDINGS

High Level Findings

Scenario	Estimated Year 0 Funding Required ¹	Estimated Term Equipment Replacement Funding Required ²	Estimated Term Operating Expenses ³	Term EVSE Electricity Penalty ⁴	Year 1 Charging Cost for 100% Recovery ⁵ (\$/kWh)	Estimated Term Net Operating Benefit ⁶
Scenario 1: EVSE on New Meters ⁷	\$(11,400,000)	\$(3,606,000)	\$(2,270,000)	\$(1,063,000)	\$0.16	\$7,800,000
Scenario 1: EVSE on Existing Meters ⁸	\$(10,700,000)	\$(3,934,000)	\$(2,447,000)	\$(2,535,000)	\$0.48	\$7,636,000
Scenario 2: EVSE on New Meters ⁷	\$(14,600,000)	\$(17,073,000)	\$(2,270,000)	\$(8,551,000)	\$0.17	\$(5,668,000)
Scenario 2: EVSE on Existing Meters ⁸	\$(21,000,000)	\$(20,019,000)	\$(3,890,000)	\$(14,480,000)	\$0.34	\$(5,260,000)

¹Includes estimates of battery energy storage system cost, solar PV system cost, electric vehicle charging station costs, and infrastructure upgrade costs.

²Includes assumed EVSE replacement every 5 years solar PV inverter replacement every 10 years, and battery system replacement in year 15.

³Includes estimates of solar PV and battery asset management costs, solar PV and battery insurance costs, solar PV and battery operations & maintenance costs, array washing costs, and contingency costs. Operation and maintenance costs for the EVSEs have been wrapped into the purchase cost.

⁴Represents all costs associated with the increase in electricity usage from the EV charging stations. Some or all these costs may be recovered when charging for EVSE use.

⁵Represents the estimated necessary charge/kWh to EVSE users to recover all costs associated with the EVSE electricity penalty.

⁶Includes an EVSE charging cost recovery assumption of approximately 100% in the New Meter scenarios, 35% in Scenario 1 Existing Meters, and 50% in Scenario 2 Existing Meters. Term assumes 25 years for EVSE and solar PV systems, and 15 years for battery energy storage systems. Does not include year 0 funding required, since this is assumed to be covered by a potential bond.

⁷Under the New Meters scenarios, the EVSEs are connected to a new meter, while the solar PV and battery energy storage systems are installed at the existing site meter. As such, the building load will be provided resiliency in the event of an outage, but the EVSEs will not.

⁸Under the Existing Meters scenarios, the solar PV and battery energy storage systems are sized to offset the increased site load after the installation of the EVSEs. This site load increase was based off assumptions included on the Key Considerations Slide and may not align with the actual usage impacts.

SUMMARY OF SCENARIO 1

Scenario 1: EVSE on New Meters

School (s)	Estimated Year 0 Funding Required ¹	Estimated Term Equipment Replacement Funding Required ²	Estimated Term Operating Expenses ³	Term EVSE Electricity Penalty ⁴	Year 1 Charging Cost for 100% Recovery ⁵ (\$/kWh)	Estimated Term Net Operating Benefit ⁶
Archie Williams (formerly Sir Francis Drake HS)	\$(3,200,000)	\$(1,030,000)	\$(920,000)	\$(238,000)	\$0.16	\$3,891,000
Redwood HS	\$(3,700,000)	\$(1,308,000)	\$(624,000)	\$(383,000)	\$0.17	\$2,043,000
New Combined San Andreas HS and Tamiscal HS	\$(2,400,000)	\$(457,000)	\$(277,000)	\$(129,000)	\$0.16	\$649,000
Tamalpais HS	\$(2,100,000)	\$(811,000)	\$(449,000)	\$(313,000)	\$0.17	\$1,217,000
Total	\$(11,400,000)	\$(3,606,000)	\$(2,270,000)	\$(1,063,000)	\$0.16	\$7,800,000

¹Includes estimates of battery energy storage system cost, solar PV system cost, electric vehicle charging station costs, and infrastructure upgrade costs.

²Includes assumed EVSE replacement every 5 years solar PV inverter replacement every 10 years, and battery system replacement in year 15.

³Includes estimates of solar PV and battery asset management costs, solar PV and battery insurance costs, solar PV and battery operations & maintenance costs, array washing costs, and contingency costs. Operation and maintenance costs for the EVSEs have been wrapped into the purchase cost.

⁴Represents all costs associated with the increase in electricity usage from the EV charging stations. Some or all these costs may be recovered when charging for EVSE use.

⁵Represents the estimated necessary charge/kWh to EVSE users to recover all costs associated with the EVSE electricity penalty.

⁶Includes an EVSE charging cost recovery assumption of approximately 100%. Term assumes 25 years for EVSE and solar PV systems, and 15 years for battery energy storage systems. Does not include year 0 funding required, since this is assumed to be covered by a potential bond.

⁷Under the New Meters scenarios, the EVSEs are connected to a new meter, while the solar PV and battery energy storage systems are installed at the existing site meter. As such, the building load will be provided resiliency in the event of an outage, but the EVSEs will not.

SUMMARY OF SCENARIO 1

Scenario 1: EVSE on Existing Meters

School (s)	Estimated Year 0 Funding Required ¹	Estimated Term Equipment Replacement Funding Required ²	Estimated Term Operating Expenses ³	Term EVSE Electricity Penalty ⁴	Year 1 Charging Cost for 100% Recovery ⁵ (\$/kWh)	Estimated Term Net Operating Benefit ⁶
Archie Williams (formerly Sir Francis Drake HS)	\$(3,000,000)	\$(1,169,000)	\$(961,000)	\$(661,000)	\$0.45	\$3,916,000
Redwood HS	\$(3,600,000)	\$(1,330,000)	\$(679,000)	\$(645,000)	\$0.57	\$2,066,000
New Combined San Andreas HS and Tamiscal HS	\$(1,800,000)	\$(465,000)	\$(297,000)	\$(360,000)	\$0.43	\$537,000
Tamalpais HS	\$(2,300,000)	\$(970,000)	\$(510,000)	\$(869,000)	\$0.46	\$1,117,000
Total	\$(10,700,000)	\$(3,934,000)	\$(2,447,000)	\$(2,535,000)	\$0.48	\$7,636,000

¹Includes estimates of battery energy storage system cost, solar PV system cost, electric vehicle charging station costs, and infrastructure upgrade costs.

²Includes assumed EVSE replacement every 5 years solar PV inverter replacement every 10 years, and battery system replacement in year 15.

³Includes estimates of solar PV and battery asset management costs, solar PV and battery insurance costs, solar PV and battery operations & maintenance costs, array washing costs, and contingency costs. Operation and maintenance costs for the EVSEs have been wrapped into the purchase cost.

⁴Represents all costs associated with the increase in electricity usage from the EV charging stations. Some or all these costs may be recovered when charging for EVSE use.

⁵Represents the estimated necessary charge/kWh to EVSE users to recover all costs associated with the EVSE electricity penalty.

⁶Includes an EVSE charging cost recovery assumption of approximately 34%. Term assumes 25 years for EVSE and solar PV systems, and 15 years for battery energy storage systems. Does not include year 0 funding required, since this is assumed to be covered by a potential bond.

⁷Under the Existing Meters scenarios, the solar PV and battery energy storage systems are sized to offset the increased site load after the installation of the EVSEs. This site load increase was based off assumptions included on the Key Considerations Slide and may not align with the actual usage impacts.

SUMMARY OF SCENARIO 2

Scenario 2: EVSE on New Meters

School (s)	Estimated Year 0 Funding Required ¹	Estimated Term Equipment Replacement Funding Required ²	Estimated Term Operating Expenses ³	Term EVSE Electricity Penalty ⁴	Year 1 Charging Cost for 100% Recovery ⁵ (\$/kWh)	Estimated Term Net Operating Benefit ⁶
Archie Williams (formerly Sir Francis Drake HS)	\$(4,000,000)	\$(4,566,000)	\$(920,000)	\$(2,324,000)	\$0.18	\$355,000
Redwood HS	\$(5,200,000)	\$(7,235,000)	\$(624,000)	\$(3,620,000)	\$0.17	\$(3,885,000)
New Combined San Andreas HS and Tamiscal HS	\$(2,500,000)	\$(1,029,000)	\$(277,000)	\$(435,000)	\$0.17	\$77,000
Tamalpais HS	\$(2,900,000)	\$(4,243,000)	\$(449,000)	\$(2,172,000)	\$0.17	\$(2,215,000)
Total	\$(14,600,000)	\$(17,073,000)	\$(2,270,000)	\$(8,551,000)	\$0.17	\$(5,668,000)

¹Includes estimates of battery energy storage system cost, solar PV system cost, electric vehicle charging station costs, and infrastructure upgrade costs.

²Includes assumed EVSE replacement every 5 years solar PV inverter replacement every 10 years, and battery system replacement in year 15.

³Includes estimates of solar PV and battery asset management costs, solar PV and battery insurance costs, solar PV and battery operations & maintenance costs, array washing costs, and contingency costs. Operation and maintenance costs for the EVSEs have been wrapped into the purchase cost.

⁴Represents all costs associated with the increase in electricity usage from the EV charging stations. Some or all these costs may be recovered when charging for EVSE use.

⁵Represents the estimated necessary charge/kWh to EVSE users to recover all costs associated with the EVSE electricity penalty.

⁶Includes an EVSE charging cost recovery assumption of approximately 100%. Term assumes 25 years for EVSE and solar PV systems, and 15 years for battery energy storage systems. Does not include year 0 funding required, since this is assumed to be covered by a potential bond.

⁷Under the New Meters scenarios, the EVSEs are connected to a new meter, while the solar PV and battery energy storage systems are installed at the existing site meter. As such, the building load will be provided resiliency in the event of an outage, but the EVSEs will not.

SUMMARY OF SCENARIO 2

Scenario 2: EVSE on Existing Meters

School (s)	Estimated Year 0 Funding Required ¹	Estimated Term Equipment Replacement Funding Required ²	Estimated Term Operating Expenses ³	Term EVSE Electricity Penalty ⁴	Year 1 Charging Cost for 100% Recovery ⁵ (\$/kWh)	Estimated Term Net Operating Benefit ⁶
Archie Williams (formerly Sir Francis Drake HS)	\$(5,300,000)	\$(5,295,000)	\$(1,414,000)	\$(3,761,000)	\$0.29	\$523,000
Redwood HS	\$(7,200,000)	\$(7,835,000)	\$(1,274,000)	\$(5,205,000)	\$0.27	\$(2,547,000)
New Combined San Andreas HS and Tamiscal HS	\$(2,300,000)	\$(1,194,000)	\$(354,000)	\$(1,251,000)	\$0.48	\$(199,000)
Tamalpais HS	\$(6,200,000)	\$(5,695,000)	\$(848,000)	\$(4,263,000)	\$0.33	\$(3,037,000)
Total	\$(21,000,000)	\$(20,019,000)	\$(3,890,000)	\$(14,480,000)	\$0.34	\$(5,260,000)

¹Includes estimates of battery energy storage system cost, solar PV system cost, electric vehicle charging station costs, and infrastructure upgrade costs.

²Includes assumed EVSE replacement every 5 years solar PV inverter replacement every 10 years, and battery system replacement in year 15.

³Includes estimates of solar PV and battery asset management costs, solar PV and battery insurance costs, solar PV and battery operations & maintenance costs, array washing costs, and contingency costs. Operation and maintenance costs for the EVSEs have been wrapped into the purchase cost.

⁴Represents all costs associated with the increase in electricity usage from the EV charging stations. Some or all these costs may be recovered when charging for EVSE use.

⁵Represents the estimated necessary charge/kWh to EVSE users to recover all costs associated with the EVSE electricity penalty.

⁶Includes an EVSE charging cost recovery assumption of approximately 50%. Term assumes 25 years for EVSE and solar PV systems, and 15 years for battery energy storage systems. Does not include year 0 funding required, since this is assumed to be covered by a potential bond.

⁷Under the Existing Meters scenarios, the solar PV and battery energy storage systems are sized to offset the increased site load after the installation of the EVSEs. This site load increase was based off assumptions included on the Key Considerations Slide and may not align with the actual usage impacts.

SUMMARY OF FINDINGS & CONSIDERATIONS

- Based on the analysis, Scenario 1: EVSE on New Meters is an option that would provide the District about \$7.8M in savings at the end of the 25-year life of the systems. It would require \$11.4M in bond funding in order to realize those savings.
 - Pros of Scenario 1: EVSE on New Meters:
 - The District can start with a smaller number of EVSEs, and then change the number of EVSEs installed over time without impacting the solar PV and battery energy storage system's savings and benefits.
 - In the event of an outage the schools will receive resiliency from the solar PV and battery energy storage system.
 - Cons of Scenario 1: EVSE on New Meters:
 - In the event of an outage the EVSEs will not receive resiliency, since they will be installed at a different meter than the solar PV and battery energy storage system.

Questions?