287 17th Street, Suite 300
Oakland, CA 94612
tel (510) 834-6420
fax (510) 834-6421
www.kw-engineering.com

Technical Contact
Warren Seto, P.E.
Senior Engineer
(510) 229-5606
seto@kw-engineering.com

Colusa Unified School District

Bright Schools Program – Scoping Audit

Site(s): **Burchfield Primary School -** 400 Fremont Street, Colusa CA 95932
Egling Middle School - 813 Webster Street, Colusa CA 95932
Colusa High School - 901 Colus Avenue, Colusa CA 95932

Date: May 15, 2014

District Contact: **Jim LaGrone**, MOT Director
(530) 458-7791, jlagrone@colusa.k12.ca.us

CEC Contact: **Jim Holland**, Project Manager
(916) 651-9857, Jim.Holland@energy.ca.gov

Summary

The California Energy Commission (Energy Commission) requested kW Engineering to conduct a scoping or walk-through audit for Colusa Unified School District. The purpose of this audit is to identify potential energy efficiency measures at the schools in the District. Engineering calculations are not included in this memo and would be part of a more in-depth Bright Schools audit.

The scoping visit was conducted on Thursday, March 20, 2014, primarily with maintenance director Jim LaGrone. This scoping audit targeted three schools in the district, Burchfield Primary, Egling Middle and Colusa High. All the District schools are served by PG&E (electricity) and natural gas.

kW Engineering recommends proceeding with an energy audit and conducting a solar assessment for the district to develop energy cost savings and investment costs for the preliminary measures identified in the initial measures list (IML) below. Priority (High/Med/Low) ratings are preliminary assessments based on expected payback, size of savings and cost, ease of construction, and District interest.

Table 1: Colusa USD - Initial Measures List

Priority	No.	Measure Name	Site	System/ Equipment	Observation	Recommendation
Medium	1	Install Occupancy Sensors in Classrooms	Burchfield Primary, Egling Middleand Colusa High Schools	Lighting	The lights in the classrooms are controlled using manual switches. The school staff usually turn off lights when spaces are not in use, but occassionally, lights are left on while unoccupied.	Controlling the light fixtures with occupancy sensors will reduce the operating time of the fixtures. Occupancy sensors will ensure that the lights are turned off when the classrooms are unoccupied.
Medium	2	Exterior Lighting	Burchfield Primary School	Exterior Lighting	There is one pole-mounted HID fixture in the parking lot that illuminates the walkway in front of the school and the flag pole at night.	Replace the HID lights with LED fixtures or induction lamps.
Medium	3	Upgrade Split-System and Heat Pump Units	Burchfield Primary, Egling Middleand Colusa High Schools	Portables	We observed wallpack heat pumps (Bard or equivalent) used to condition the portable classrooms.	Upgrade the heat pumps to Title 24 standards or better. Include economizers on wall pack units.
Medium	4	Replace Rooftop Units with New Efficient Units	Burchfield Primary, Egling Middleand Colusa High Schools	HVAC	The packaged units on these campuses are between 10-30 years old. Most of the package units have economizers, however many of them are non-operational. All of the packaged units we investigated use R-22 refrigerant.	Replace the existing packaged rooftop units (RTUs) with similarly sized high efficiency packaged units that exceed the minimum-efficiency requirements outlined in Title 20 (for units less than 5.5 tons) and Title 24 (all other units). Newly installed packaged units will also provide functioning economizers, to provide maximum free-cooling during moderate conditions and minimizing outside air during temperature extremes.
Medium	5	Wireless-Enabled Thermostats	Burchfield Primary, Egling Middleand Colusa High Schools	HVAC Controls	The thermostats in the classrooms are mostly digital thermostats, but are not programmed with setback schedules. Staff can manually turn on and adjust the temporary setpoint. The district began installing a few wireless network thermostats at Colusa High School.	Install wireless-enabled thermostats which can be controlled and monitored from a remote location by facility maintenance staff. The thermostats can be programmed to operate based on classroom schedules. The thermostats should have a temporary manual override for occasions when classrooms are occupied outside of the regular schedules.
Medium	6	Solar PV	Burchfield Primary, Egling Middleand Colusa High Schools	Generation	The schools have open solar access in parking lots and many exposed roof surfaces.	Perform a solar PV feasibility study to look at installation at any of the campuses.
Medium	7	Replace Exterior HPS Fixtures with Bi-Level, LED Fxitures	Egling Middle School and Colusa High School	Exterior Lighting	The parking lot and walkways security lights use high pressure sodium lamps. The security lights are controlled by photocells.	Replace the high pressure light fixtures with bi-level LED fixtures equipped with motion sensors mounted at the flood height. The bi-level switching will allow the luminaires to reduce light output(and power consumption) when no motion has been detected for a specified period of time (often 5 minutes).
Medium	8	Replace Restrioom Lighting with Daylighting Fixtures	Colusa High School	Lighting Controls	The boys and girls restroom with skylights provide ample ambient light to illuminate the space.	Install new fixtures with integrated photocells and dimming ballasts.
Medium	9	Separate Supply Air Register from Return Air Register	Colusa High School	Dist. System	The supply and return air registers are close to each other. This may cause some of the supply air to directly flow into the return air register, or short circuit the air flow. This results in reduced effectiveness of the supply air and causes longer cycling times because it takes a longer time for the space to reach the desired temperature.	Add ductwork to separate the supply air register from the return air register.
Low	10	Replace 32-watt T8 Lamps with 28-watt T8 Lamps	Burchfield Primary, Egling Middleand Colusa High Schools	Lighting Interior	The lights in the classrooms use 32-watt, 4100 kelvin T8 lamps with electronic ballasts. The district is considering replacing the lamps with energy-saving 28-watt T8 lamps and premium efficiency ballasts.	Replace the existing 32-watt T8 lamps with latest-generation 28 watt F28T8 lamps. The new 28W lamps should be installed when most existing lamps are due for replacement. Ballast manufacturers should be contacted prior to installing 28 watt lamps to ensure that the ballast is compatible with the 28 watt lamp.

Burchfield Primary School

The original school was built in 1955. The school has 3 permanent buildings that contain classrooms, a library, administrative offices, and a cafeteria. The total building area is 34,587 square feet. The school has an average daily attendance of about 450 students. The campus operates on a typical school schedule. Classes are in session on school days from approximately 8:15 a.m. until 2:15 p.m. The school has five electric meters and three natural gas meters. Burchfield Primary School campus is shown in Figure 1.

Figure 1: Aerial View of Burchfield Elementary School

Billing and Benchmarking

The following table provides a summary of the energy usage and building area[1]:

Table 2: Energy Efficiency Measures Summary

Facility Name	Area (sq.ft.)	Electric Usage (kWh)	Electric Cost ($)	Natural Gas Usage (therms)	Natural Gas Cost ($)	Energy Costs/Sq. Ft.
Burchfield Primary School	34,587	269,874	$51,859	3,030	$107	$1.50

[1] Data originally provided by the Energy Commission. The natural gas total updated to include a second meter.

Electrical and Mechanical Systems

This section describes the types of lighting and heating, ventilation, and air-conditioning (HVAC) systems that kW Engineering assessed during the scoping audit.

Interior Lighting

The classroom lighting is primarily recessed fluorescent T8 troffer fixtures with prismatic lenses. Hallway lighting consists of ceiling mounted T8 fixtures with prismatic wrap lenses. There are also 4'x4' box framed fixtures with T8 lamps in the cafeteria. The fixtures throughout the school are mainly controlled with manual switches, with the exception of permanent classrooms 12 through 15, which also have daylight sensors to turn off lighting in the classrooms. Lamps are 32 watts and typically 4100 kelvin.

Figure 2: Cafeteria (Top Left), Hallway (Top Right) and Classroom T8 Fixtures (Middle Left), Typical Light Switches (Middle Right) and Daylight Sensor (Bottom)

Exterior Lighting

There are wallpacks by the door of each classroom that open up to the outside. The wallpacks each have 26-watt compact fluorescent lamps (CFLs) and integrated photocells. There is also one pole mounted dual head light fixture with high intensity discharge (HID) lamps that is used to illuminate a flag pole and to illuminate the walkway in front of the school office.

Figure 3: CFL Wall Pack with Integrated Photocell (Left), Pole Mounted Exterior HID Fixtures (Right)

HVAC

The permanent classrooms use packaged rooftop units (RTUs) and portable classrooms use wall-mounted gas packs. The HVAC equipment is controlled by digital programmable thermostats. It was observed that although the thermostats were locked to prevent tampering with the settings, the thermostat settings were not uniform and date and time settings were also not calibrated. During the scoping audit, we observed that a window was open in one of the permanent classrooms while the air conditioning equipment was running.

Based on an analysis of the annual energy use, there is significant energy use during the summer, even though school is not in session. This suggests that HVAC equipment is running during the summer. The school district is considering installing wireless thermostats throughout the school, which would allow maintenance personnel to monitor and control the thermostats and turn off equipment from a central and/or remote location.

Figure 4: Permanent Classroom Rooftop Units (Top Left), Portable Classroom Gas Pack Units (Top Right), Digital Thermostat (Bottom)

The cafeteria is conditioned with gas furnaces and has an 80% thermal efficiency water heater for domestic hot water.

Figure 5: Domestic Hot Water Heater (Left), Gas Furnaces (Right)

Renewable Energy

There is potential for adding photovoltaic (PV) solar panels on the staff parking lot in front of the school.

Egling Middle School

The original school was built in 1976. The school has 5 permanent buildings that contain classrooms, a gymnasium, cafeteria band room and administrative offices. The school also has 10 portable classrooms. The total building area is 50,438 square feet.The school has an average daily attendance of about 500 students. The campus operates on a typical school schedule. Classes are in session on school days from approximately 8:00 a.m. until 2:30 p.m. The school has six electric meters and five natural gas meters. Egling Middle School campus is shown in Figure 6.

Figure 6: Aerial View of Egling Middle School

Billing and Benchmarking

The following table provides a summary of the energy usage and building area[2]:

Table 3: Energy Efficiency Measures Summary

Facility Name	Area (sq.ft.)	Electric Usage (kWh)	Electric Cost ($)	Natural Gas Usage (therms)	Natural Gas Cost ($)	Energy Costs/Sq. Ft.
Egling Middle School	50,438	593,176	$108,260	15,195	$12,465	$2.39

[2] Data provided by the Energy Commission.

Electrical and Mechanical Systems

Interior Lighting

The lighting throughout is primarily recessed fluorescent troffer fixtures. The music room has suspended downlight fixtures with prismatic wrap lenses. The gymnasium has ceiling mounted strip fixtures. Each of these fixtures contain two fluorescent 4-foot T8 lamps. The fixtures are controlled with manual controls. Lamps are 32 watts and typically 4100 kelvin.

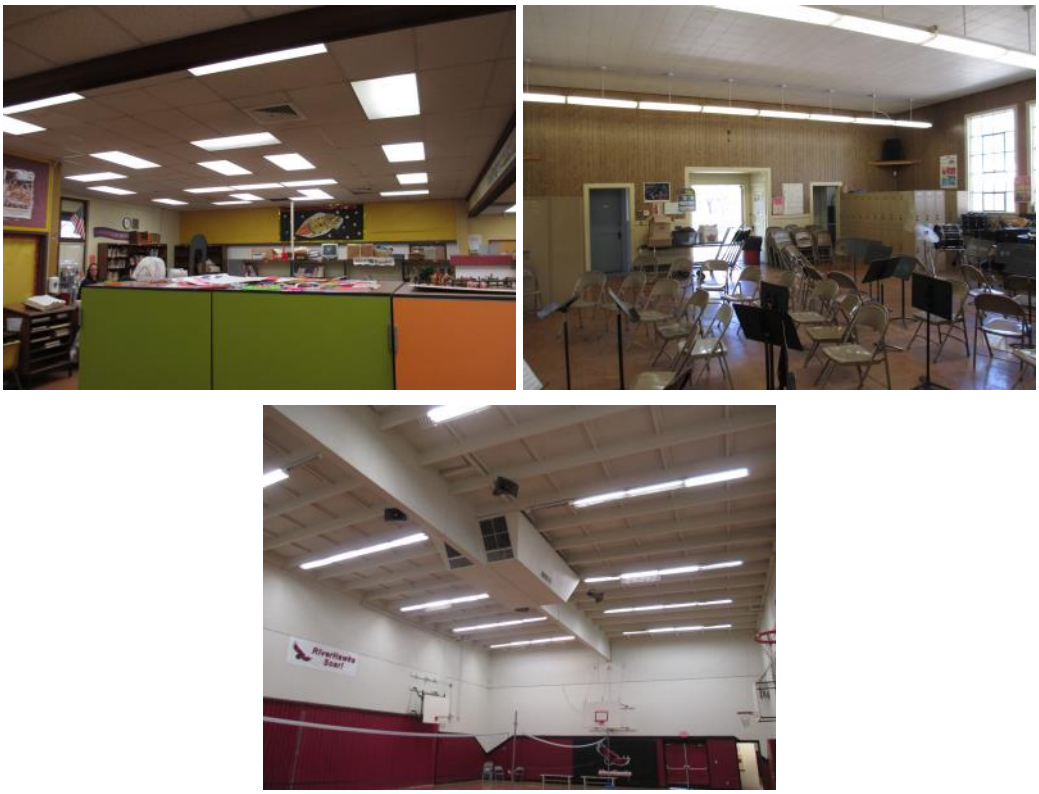

Figure 7: Recessed Troffer (Top Left), Suspended (Top Right) and Ceiling Mounted T8 Fixtures (Bottom)

Exterior Lighting

The walkway downlight fixtures each have a 13-watt screw-in compact fluorescent lamp (CFL). There is also a pole-mounted 400-watt high pressure sodium (HPS) fixture that illuminates the basketball courts at night; this also serves as a security light. The exterior fixtures are controlled by photocell.

Figure 8: 13-Watt Walkway Fixtures (Top), HPS Fixture (Bottom)

HVAC

The permanent classrooms have large, single zone packaged rooftop units. Although the RTUs are single zone, each unit serves at least four classrooms. Thus, a digital thermostat in one classroom controls the temperature of the other three classrooms. It was also noticed that a door to one of the classroom was open to the exterior while the RTU was running; this classroom did not have a thermostat. During the scoping audit, the inspector did not have access to the rooftop units.

The portable classrooms have either gas packs or heat pumps and are controlled by digital thermostats. The digital thermostats are set up with temperature setbacks of 55°F for heating and 85°F for cooling every day. The thermostats are locked to prevent schedule changes, but staff has access to change the temperature setpoint. The operation of the gas packs and heat pumps are limited by one-hour twist timers.

Figure 9: Digital Thermostat with One-Hour Twist Timer Control

Colusa High School

The original school was built in 1955. The school has 5 permanent classrooms that contain classrooms, workshops, gymnasium, band room and administrative offices. The school also has 8 portable building that serve as classrooms, storage units and engineering offices. The total building area is 77,559 square feet. The school has an average daily attendance of about 350 students. The campus operates on a typical school schedule. Classes are in session on school days from approximately 7:00 a.m. until 3:00 p.m. The school has eleven electric meters and two natural gas meters. Colusa High School campus is shown in Figure 10.

Figure 10: Aerial View of Colusa High School

Billing and Benchmarking

The following table provides a summary of the energy usage and building area[3]:

Table 4: Energy Efficiency Measures Summary

Facility Name	Area (sq.ft.)	Electric Usage (kWh)	Electric Cost ($)	Natural Gas Usage (therms)	Natural Gas Cost ($)	Energy Costs/Sq. Ft.
Colusa High School	77,559	595,443	$104,150	25,536	$20,902	$1.61

[3] Data provided by the Energy Commission.

Electrical and Mechanical Systems

Interior Lighting

All interior light fixtures are controlled with manual switches.

The lighting consists of recessed troffer, suspended and ceiling mounted fixtures that contain fluorescent T8 lamps. Each T8 fixture contains two fluorescent 4-foot T8 lamps. Lamps are 32 watts and typically 4100 kelvin. The school began replacing the 32 watt lamps with 28 watt lamps, but the maintenance director estimates that only 1% of the fixtures have been retrofitted with the energy-saving T8 lamps.

Figure 11: Sample T8 Fixture Types

The gymnasium uses high bay ceiling mounted T5 fixtures.

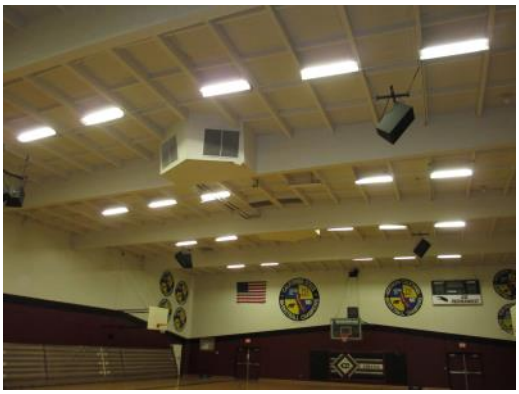

Figure 12: Gym Fixtures

The school also uses compact fluorescent lamps in circular recessed fixtures in the administrative office and pendant lamps in the boiler room.

Figure 13. Recessed Circular Can Fixtures (Left), Pendant Fixtures (Right)

The permanent building that contains Rooms 500 through 508 has boys and girls restrooms with CFL-based circular fixtures. The restrooms have large skylights which provide ample daylighting to the space. The light fixtures in the restrooms are manually controlled and are left on during the day. There are also skylights that illuminate the main hallway through this building, but the skylights are covered with rust due to a metal security gate that was installed to prevent vandalism. The rust on the skylights reduces the amount of daylight through the light wells and also produces a brown-colored light. The maintenance manager said that the metal gates could be removed because all roof access has been secured since the installation of the metal gates.

Figure 14. Skylight in Boys Restroom with Lights On (Top Left), Hallway with Brown-Colored Light through Skylight (Top Right), Metal Security Gate over Skylight (Bottom)

Exterior Lighting

There are approximately 80 wallpacks with integrated photocells around the perimeter of the school. The wallpacks are being upgraded from CFL to LED-based wallpacks. Approximately 30 wallpacks have been replaced with LED wallpacks to date. The CFL-based wallpacks use 13-watt screw-in lamps. There are also 1-lamp T8 fixtures under the awnings by some classrooms.

Figure 15: 13-Watt CFL Wallpack Fixture (Top Left), LED Wallpack Fixture (Top Right), Exterior T8 Fixture (Bottom)

There are several high pressure sodium fixtures around the school that provide security lighting at night. The exterior fixtures are controlled by photocells.

Figure 16: HPS Security Light Fixtures (Top) and Photocell (Bottom)

HVAC

The permanent classrooms are mainly served by single zone rooftop units and are controlled by digital thermostats. The supply and return ducts share the same plenum and the supply and return diffusers are positioned next to each other. This causes some of the supply air to flow directly into the return air duct before having a chance to circulate through the room; this is also known as short circuiting. It was also noticed that a door to one classroom was open to the exterior while the RTU was running; this classroom did not have a thermostat.

Figure 17. Packaged RTU (Top Left), Supply and Return Ducts on Common Shaft (Top Right), Digital Thermostat (Bottom)

There are some classrooms that use packaged gas furnace/air conditioning units. It was noted that the supply and return air diffusers for these units were close together and may also experience air flow short circuiting.

Figure 18. Packaged Gas Furnace/Air Conditioner (Left) and Supply and Return Air Diffusers (Right)

The portable buildings use either gas packs or heat pumps and are controlled by digital thermostats. The digital thermostats are set up with temperature setbacks of 55°F for heating and 85°F for cooling every day. The thermostats were not set up with daily schedules, so the units can operate during non-school days if thermostats are inadvertently left in the ON position. The thermostats are locked to prevent schedule changes, but staff has access to change the temperature setpoint.

Figure 19. Portable Building with Wall Mounted Heat Pump

The school is in the process of upgrading the digital thermostats with wireless thermostats, which will give maintenance staff the ability to control the room temperature and operating schedule via a web browser from a web-enabled device. The wireless thermostats have been installed in six rooms to date.

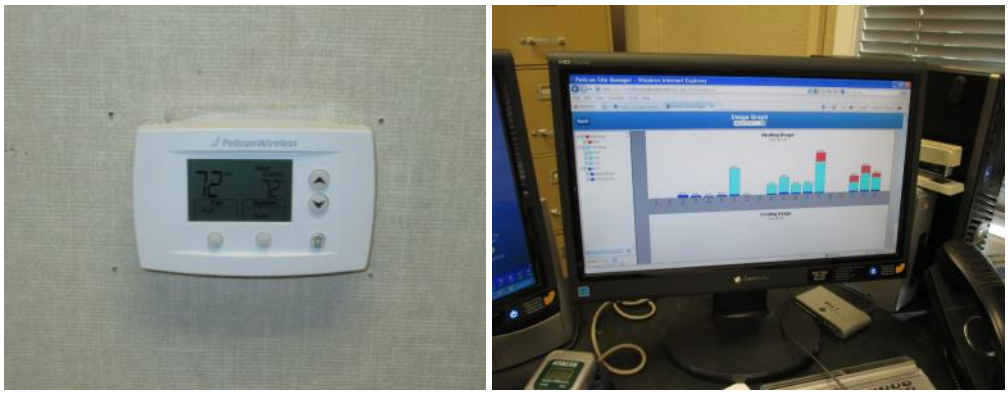

Figure 20: Wireless Digital Thermostat (Left),
Web-Enabled Wireless Thermostat Manager (Right)