

EPC-15-085: Updated City of San Diego Public Library ZNE ECMs and Modeled Savings

Updated Energy Conservation Measures & Modeling Results (July 2019)

	Malcom X Library			Point Loma Library			Serra Mesa Library		
	Energy Savings (kWh/yr.)	Peak Demand Savings (kW)	Electrical Cost Savings (\$/yr.)	Energy Savings (kWh/yr.)	Peak Demand Savings (kW)	Electrical Cost Savings (\$/yr.)	Energy Savings (kWh/yr.)	Peak Demand Savings (kW)	Electrical Cost Savings (\$/yr.)
ECM 1 – Lighting Retrofit	55,201	15.3	\$9,053	85,106	19.9	\$8,908	20,355	3.9	\$3,903
ECM 2 – Lighting Controls	11,601	3.4	\$1,408	9,636	2.4	\$876	3,291	0.7	\$624
ECM 3 – HVAC Unit Replacement									
ECM 4 – HVAC Ventacity									
ECM 5 – HVAC Controls	10,706	13.1	\$2,282	23,141	18.2	\$4,137	4,966	2	\$705
ECM 6 – Plug Load Mgmt. (BertBrain)	2,402	0.3	\$153	6,037	1.6	\$568	5,563	2.4	\$764
ECM 7 – Envelope (Malcolm X)	1,699	0.7	\$274						
Jul. 2019 Est. Savings	81,609 kWh/yr.	32.8 kW	\$13,170/yr.	123,920 kWh/yr.	42 kW	\$14,489	34,175 kWh/yr.	9 kW	\$5,996/yr.
Feb. 2019 Est. Savings	84,272 kWh/yr.	41 kW	\$23,091/yr.	115,024 kWh/yr.	42 kW	\$31,517	38,687 kWh/yr.	23 kW	\$9,672/yr.

Presented above are CSE & Mazzetti’s (the project team) modeled energy conservation measure (ECM) energy and cost savings. This analysis, requested by the Energy Commission in June 2019, supplements the proposed ECMs and performance results presented in CSE’s February 2019 *Report of Integration Activities*. Following the completion of this report, the project team continued evaluating the energy savings potential of each proposed ECM through improved modeling techniques, as well as cost-effectiveness and procurement lead times. The results of the team’s further evaluation between March and May 2019 resulted in the elimination of ECM 3 (HVAC unit replacements due to cost & lead time) and ECM 4 (Ventacity Heat Recovery Ventilator due to cost & low energy savings), pages 5 & 6 in CSE’s report, respectively. The information provided in this update includes the project team’s improved modeling approach and a refined list of ECMs energy/cost savings that result directly from this analysis. In short, the project team estimates that all currently proposed ECMs will save the City of San Diego approximately **239,704 kWh per year, reduce demand by 84 kW, and \$33,655 per year.**

When the project team compares these estimates to each library’s measured baseline analysis (provided in Oct. 2018), coupled with current on-site PV production, Malcolm X is projecting to fully achieve ZNE, with Serra Mesa being near-ZNE (w/in ~18,000* kWh), and Point Loma as high-performance (w/in ~169,000 kWh*).

*Result = (Baseline kWh - est. Annual PV Production) - est. Jul. 2019 Additive Model Savings

Additive Modeling

Energy Pro is used by the project team to model ECMs for consideration at all three libraries. Each measure was entered into Energy Pro as specified by the design engineer, Mazzetti. In early 2019, the project team applied proposed ECMs to each library's calibrated model developed in Oct. 2018.

The primary objective of this modeling was to determine if the Feb. 2019 estimated savings were achievable while considering the importance of the grant's objective: to achieve of ZNE or near-ZNE at these libraries. Energy Pro does not perform parametric modeling, so these measures were performed with an additive approach where we started with the baseline models and then created new files for each measure in order to isolate estimated energy savings by ECM, such as:

- Baseline Model
- Baseline Model + ECM 1
- Baseline Model + ECM 2 + n

The difference in modeled energy use between each version of the bld. file is taken as the energy savings of each measure. This method may not completely consider the interactivity of each measure because of the way it is built, for instance the Baseline + ECM 1 model is unaware of the impacts of the measure in Baseline + ECM 1 + ECM 2, etc. However, the missed interactivity of these measures is likely negligible because, for example lighting measures are simulated prior to HVAC measures so the most common and largest interactions between measures is captured.

ECM-4: Ventacity Energy Savings at Malcolm X Library (removal justification)

The Energy Commission also requested further detail on the project team's decision to remove ECM-4 from the project design. This information provides the analysis performed to determine the viability of the measure which was ultimately determined to not be viable due to minimal-to-ineffective energy reductions, as well as, a ~100-year payback which defies the principle of cost-effectiveness and an objective of this grant.

The Ventacity equipment selection that was provided by Aubrey Gewehr (Ventacity) was used as the basis for the equipment parameters used to model the potential savings of implementing a heat recovery system (ERV) the at Malcolm X Library.

The parameters entered are as follows:

- Energy Recovered: (Total)
- Heat Recovery Effectiveness: 0.766
- Minimum Delta T required for Heat Recovery: 5 deg F
- Electrical Energy Use / Fan Power: 2.56 hp (1.91 kW)
- Fan or Pumps only run when energy recovery is possible checked
- Fan energy savings when heat recovery is in bypass: 90% because of VFD and affinity laws.
- Exhaust Air Stream Evaporative Cooling Effectiveness: 0.769

As mentioned above, Energy Pro does not provide itemized energy savings for each measure so individual files were created to represent each measure. To isolate the Ventacity savings the model was run with all measures in place with and without this ERV measure and the difference is the potential

savings of an ERV installation on this zone at Malcolm X Library. Electrical energy savings of this measure are estimated **3,737 kWh/year** and **peak demand is reduced 2.1 kW** per month per year. There is a 2 Therms per year energy penalty. The total cost savings for this measure is approx. **\$668 per year** according to Energy Pro outputs. The simple payback for this implementation is **125.5 years**.

As a verification to ensure that inputs are in line, the same measure was run again and the heat recovery effectiveness was increased to an ideal 100%, which is not possible in a real building but provides some indication of an energy savings ‘high water mark.’ The savings from this ideal 100% effective system is \$839 per year with a simple payback of 99.9 years.

The conclusion of the project team’s analysis is that implementation of the Ventacity system at Malcolm X Library is too costly for nominal energy savings and is not recommended for this site. Results of 3 energy modeling runs are shown below; all measures except ERV, all measures with ERV as proposed by Ventacity and all measures with an ideal ERV system (no existent).

	PV + All measures except Ventacity					PV + All measures including Ventacity					PV + All measures including 100% eff. ERV				
	Energy Use (kWh)	Peak Demand (kW)	Electrical Cost	Energy Use (Therms)	Gas Cost	Energy Use (kWh)	Peak Demand (kW)	Electrical Cost	Energy Use (Therms)	Gas Cost	Energy Use (kWh)	Peak Demand (kW)	Electrical Cost	Energy Use (Therms)	Gas Cost
Jan	3,898	60.2	\$1,962	310	\$256	3,832	58.1	\$1,921	310	\$256	3,762	57.6	\$1,909	310	\$256
Feb	1,706	55.7	\$1,843	134	\$116	1,582	53.6	\$1,805	134	\$116	1,543	53.2	\$1,791	134	\$116
Mar	-2,174	62.2	\$2,104	195	\$165	-2,324	60.2	\$2,036	195	\$165	-2,383	59.7	\$2,021	195	\$165
Apr	-3,667	53.8	\$1,827	78	\$72	-3,921	51.7	\$1,759	79	\$72	-4,013	51.3	\$1,744	79	\$72
May	-4,116	49.5	\$1,787	48	\$48	-4,454	47.5	\$1,714	48	\$48	-4,559	47.0	\$1,697	48	\$48
Jun	-2,171	57.5	\$2,026	15	\$22	-2,638	55.5	\$1,951	15	\$22	-2,745	55.0	\$1,935	15	\$22
Jul	1,048	63.0	\$2,185	14	\$21	542	60.9	\$2,110	14	\$21	434	60.4	\$2,094	14	\$21
Aug	3,910	80.9	\$2,782	14	\$21	3,378	78.8	\$2,708	14	\$21	3,255	78.3	\$2,691	14	\$21
Sep	4,448	90.1	\$3,250	13	\$21	3,983	88.0	\$3,176	14	\$21	3,868	87.6	\$3,159	14	\$21
Oct	4,277	61.7	\$2,274	17	\$24	3,847	59.6	\$2,199	17	\$24	3,735	59.1	\$2,183	17	\$24
Nov	4,144	68.9	\$2,344	28	\$33	3,814	66.8	\$2,276	28	\$33	3,722	66.4	\$2,261	28	\$33
Dec	4,365	51.2	\$1,777	194	\$164	4,290	53.1	\$1,838	194	\$164	4,180	53.1	\$1,837	194	\$164
Total (Maximum)	15,668	90.1	\$26,161	1,060	\$963	11,931	88.0	\$25,493	1,062	\$963	10,799	87.6	\$25,322	1,062	\$963

Electrical Energy Savings (kWh/yr)	3,737	Electrical Energy Savings (kWh/yr)	4,869
Electrical Demand Savings (kW/)	2.1	Electrical Demand Savings (kW/)	2.5
Electrical Cost Savings (\$/yr)	\$668	Electrical Cost Savings (\$/yr)	\$839
Gas Savings (Therms/yr)	-2	Gas Savings (Therms/yr)	-2
Gas Cost Savings (\$/yr)	\$0	Gas Cost Savings (\$/yr)	\$0
Estimated Project Cost	\$83,845	Estimated Project Cost	\$83,845
Simple Payback (yrs)	125.5	Simple Payback (yrs)	99.9