

ENERGY CALCULATIONS

ATTACHMENT 4

to the
439 Eccles Avenue Project Environmental Checklist

Construction Energy Use

To support the Energy Analysis for the following project: 439 Eccles Avenue

Construction Equipment/Vehicles

	# of Vehicles	Hrs per Day	Horse-power	Load Factor	Days in Phase	Fuel Used (gallons)
Demolition						
Rubber Tired Dozers	1	8	247	0.4	20	836
Concrete Saws	1	8	81	0.73	20	556
Tractors/Loaders/Backhoes	3	8	97	0.37	20	1,013
Site Preparation						
Graders	1	8	187	0.41	3	97
Scrapers	1	8	367	0.48	3	224
Tractors/Loaders/Backhoes	1	7	97	0.37	3	44
Grading / Excavation						
Graders	1	8	187	0.41	62	2,012
Rubber Tired Dozers	1	8	247	0.4	62	2,592
Tractors/Loaders/Backhoes	2	7	97	0.37	62	1,832
Building - Exterior						
Cranes	1	8	231	0.29	480	13,608
Forklifts	2	7	89	0.2	480	7,033
Generator Sets	1	8	84	0.74	480	14,035
Tractors/Loaders/Backhoes	1	6	97	0.37	480	6,078
Welders	3	8	46	0.45	480	14,022
Paving						
Cement and Mortar Mixers	1	8	9	0.56	10	24
Pavers	1	8	130	0.42	10	231
Paving Equipment	1	8	132	0.36	10	201
Rollers	2	8	80	0.38	10	286
Tractors/Loaders/Backhoes	1	8	97	0.37	10	169

Building - Interior / Architectural Coating						
Air Compressors	1	6	78	0.48	10	132
Total Fuel Used for Construction Equipment/Vehicles						65,026 (diesel)

Compression-Ignition Engine Brake-Specific Fuel Consumption (BSFC) Factors [1] used in the above calculations are (in gallons per horsepower-hour/BSFC)

0.0588 <100 horsepower
0.0529 >100 horsepower

Worker Trips

Phase	MPG [2]	Trips	Trip Length (miles)	Total Miles per Day	Days in Phase	Fuel Used (gallons)
Demolition	24	13	10.8	140.4	20	117
Site Prep Phase	24	8	10.8	86.4	3	11
Grading Phase	24	10	10.8	108	62	279
Paving	24	15	10.8	162	10	68
Building Construction	24	169	10.8	1825.2	480	36,504
Architectural Coating	24	34	10.8	367.2	10	153
Total Fuel Used for Construction Worker Trips						37,131 (gasoline)

Construction Energy Use, Continued

Vendor Trips

Phase	MPG [2]	Trips	Trip Length (miles)	Total Miles per Day	Days in Phase	Fuel Used (gallons)
Demolition	7.4	0	7.3	0	20	0
Site Prep Phase	7.4	0	7.3	0	3	0
Grading Phase	7.4	0	7.3	0	62	0
Paving	7.4	0	7.3	0	10	0
Building Construction	7.4	77	7.3	562.1	480	36,461
Architectural Coating	7.4	0	7.3	0	10	0
Total Fuel Used for Vendor Trips						36,461 (diesel)

Hauling Trips

Phase	MPG [2]	Trips in Phase	Trip Length (miles)	Total Miles in Phase	Fuel Used (gallons)
Demolition	7.4	183	20	3660	495
Site Prep Phase	7.4	0	20	0	0
Grading Phase	7.4	5062	20	101240	13,681
Paving	7.4	0	20	0	0
Building Construction	7.4	0	20	0	0
Architectural Coating	7.4	0	20	0	0
Total Fuel Used for Hauling Trips					14,176 (diesel)

Fuel Use Converted to MMBtu

	Total Construction Fuel Use (gallons)	Conversion Factor Btu/gallon	Source	Fuel Converted to Energy Use
Diesel	115,662	137,381	[3]	15,890 MMBtu
Gasoline	37,131	109,786	[4]	4,076 MMBtu
Total Energy Use from Construction Fuel				19,966 MMBtu

Sum of above

Total Construction Energy Use 19,966 MMBtu

Operational Energy Use

Operational Vehicular Fuel Use

Gross Annual VMT	3,681,522
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Fleet Class	Fleet Mix	VMT per Class	Fuel Economy [5]	Fuel Consumption (gallons)	
Light Duty Auto (LDA)	0.457911	1685809.4	30.9	54556.94	
Light Duty Truck 1 (LDT1)	0.074699	275006.01	26.63	10326.92	
Light Duty Truck 2 (LDT2)	0.239011	879924.25	24.36	36121.69	
Medium Duty Vehicle (MDV)	0.149017	548609.36	20.2	27158.88	
Motorcycle (MCY)	0.029236	107632.98	37.06	2904.29	Total Gasoline 131,069
Light Heavy Duty 1 (LHD1)	0.025897	95340.375	18.23	5229.86	gallons
Light Heavy Duty 2 (LHD2)	0.006576	24209.689	16.24	1490.74	
Medium Heavy Duty (MHD)	0.010546	38825.331	9.43	4117.21	
Heavy Heavy Duty (HHD)	0.001994	7340.9549	6.42	1143.45	
Other Bus (OBUS)	0.001422	5235.1243	8.26	633.79	
Urban Bus (UBUS)	0.000553	2035.8817	5.17	393.79	
School Bus (SBUS)	0.000429	1579.3729	7.25	217.84	
Motorhome (MH)	0.00271	9976.9246	9.91	1006.75	Total Diesel 14,233
					gallons

Note that the above VMT includes a 21% reduction for the TDM plan [6].

Note that the above numbers represent gross fuel consumption.

	Total Fuel Use (gallons)	Conversion Factor Btu/gallon	Source	Fuel Converted to Use	Energy
Diesel	14,233	137,381	[3]	1,955 MMBtu	
Gasoline	131,069	109,786	[4]	14,390 MMBtu	
Total Energy Use from Operational Fuel					16,345 MMBtu

Operational Built Environment

Type of Energy	Annual Usage	Units	Converted to MMBtu
Electricity	3.16E+06 kWh		10778
Natural Gas	7242870 kBtu		7242.87

Sum of above

Total Annual Operational Energy Use	34,366 MMBtu
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Sources

Unless otherwise noted, information in these calculations is from the project-specific Air Quality/Emissions Assessment for the project, including CalEEMod output tables.

[1] United States Environmental Protection Agency. 2018. Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES2014b . July 2018. Available at: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100UXEN.pdf>.

[2] United States Department of Transportation, Bureau of Transportation Statistics. 2018. National Transportation Statistics 2018 . Available at: <https://www.bts.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-anddata/national-transportation-statistics/223001/ntsntire2018q4.pdf>.

<https://www.eia.gov/totalenergy/data/monthly/archive/00352205.pdf>

[4] California Air Resources Board, CA-GREET 2.0 Supplemental Document and Tables of Changes, Appendix C, Supplement to the LCFS CA-GREET 2.0 Model, 12/15/2014 , page C-24, Table 10. Available at: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2015/lcfs2015/lcfs15appc.pdf>

[5] California Air Resources Board (CARB), EMFAC2021 v1.0.0., 2021. Available at <https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and>

[6] Anticipated TDM reduction information is from the the project-specific CEQA Transportation Analysis.

Acronyms used include:

Btu = British Thermal Units

hrs = hours

kBtu = Thousand British Thermal Units

kWH = kilowatt hours

MMBtu = Million British Thermal Units

MPG = miles per gallon

TDM = Transportation Demand Management

VMT = vehicle miles traveled