# Appendix F:
# Energy Supporting Information

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# Appendix E

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**Project Energy Use Summary**

| **Summary of Energy Use During Construction** | | (Annually) |
|---|---|---|
| Construction vehicle fuel | 114 | gallons (gasoline, diesel) |
| Construction equipment fuel | 1,447 | gallons (diesel) |
| Total construction fuel | 1,561 | gallons (gasoline, diesel) |
| Construction office electricity | 415 | kilowatt hours |

**Construction Vehicle Fuel Calculations**

California Air Resource Board (ARB). 2020. EMFAC2014 Web Database. Website: https://www.arb.ca.gov/emfac/2014/. Accessed June 9, 2021.

VMT = Vehicle Miles Traveled
FE = Fuel Economy

EMFAC2014 (v1.0.7) Emissions Inventory
Region Type: County
Region: San Joaquin
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

| | | | | | | | | | | Calculations | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | CalYr | VehClass | MdlYr | Speed | Fuel | Population | VMT (mi/day) | Trips | Fuel_Consumption (1000 gallons/day) | FE (mi/gallon) | VMT*FE |
| San Joaquin | 2021 | HHDT | Aggregated | Aggregated | GAS | 34.857671 | 4726.33419 | 697.4323 | 1.013811 | 4.661948815 | 22033.92808 |
| San Joaquin | 2021 | HHDT | Aggregated | Aggregated | DSL | 8453.9325 | 1280271.888 | 0 | 213.3155 | 6.001776367 | 7683905.564 |
| San Joaquin | 2021 | LDA | Aggregated | Aggregated | GAS | 301960.24 | 12223456.17 | 1898810 | 408.4002 | 29.93009483 | 365849202.4 |
| San Joaquin | 2021 | LDA | Aggregated | Aggregated | DSL | 2957.0418 | 128308.8047 | 18417.33 | 3.27996 | 39.11901111 | 5019313.558 |
| San Joaquin | 2021 | LDT1 | Aggregated | Aggregated | GAS | 23974.062 | 835281.3714 | 143631.1 | 33.57241 | 24.87999106 | 20781793.05 |
| San Joaquin | 2021 | LDT1 | Aggregated | Aggregated | DSL | 33.185926 | 779.7401813 | 162.1496 | 0.0279 | 27.94768344 | 21791.93175 |
| San Joaquin | 2021 | LDT2 | Aggregated | Aggregated | GAS | 105773.44 | 4223645.455 | 664056.5 | 190.05 | 22.22386822 | 93865740.02 |
| San Joaquin | 2021 | LDT2 | Aggregated | Aggregated | DSL | 156.87962 | 7199.509542 | 1006.029 | 0.236958 | 30.38308533 | 218743.3127 |
| San Joaquin | 2021 | LHDT1 | Aggregated | Aggregated | GAS | 6883.9 | 199682.2274 | 102559.9 | 20.7818 | 9.60851596 | 1918649.869 |
| San Joaquin | 2021 | LHDT1 | Aggregated | Aggregated | DSL | 7675.1136 | 245900.9268 | 96543.27 | 14.19055 | 17.32849472 | 4261092.912 |
| San Joaquin | 2021 | LHDT2 | Aggregated | Aggregated | GAS | 914.60011 | 32880.05128 | 13626.18 | 3.73525 | 8.802637836 | 289431.1835 |
| San Joaquin | 2021 | LHDT2 | Aggregated | Aggregated | DSL | 2117.7808 | 79458.90509 | 26639.02 | 5.040329 | 15.76462636 | 1252639.95 |
| San Joaquin | 2021 | MHDT | Aggregated | Aggregated | GAS | 635.14712 | 33743.10733 | 12708.02 | 5.256211 | 6.419664084 | 216619.4142 |
| San Joaquin | 2021 | MHDT | Aggregated | Aggregated | DSL | 6905.1787 | 339552.9664 | 0 | 41.16197 | 8.249191824 | 2801037.554 |

**Worker**
**Sum of VMT*FE (Column BI) 485756584.2**
**Total VMT 17418671.05**
**Weighted Average FE 27.88712082**

**Vendor**
**Sum of VMT*FE (Column BI) 18445410.37**
**Total VMT 2216216.407**
**Weighted Average FE 8.322928355**

**Haul**
**Sum of VMT*FE (Column BI) 7705939.492**
**Total VMT 1284998.223**
**Weighted Average FE 5.996848366**

**Project Construction Assumptions**

Source: AQ/GHG Appendix, CalEEMod Output
Tracy Electronic Billboard Project - Mitigated Construction - San Joaquin County, Annual
Date: June 9, 2021

| Construction Schedule | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days |
|---|---|---|---|---|---|---|
| | Demolition | Demolition | 9/1/2021 | 9/3/2021 | 5 | 2 |
| | Grading | Grading | 9/4/2021 | 9/5/2021 | 5 | 1 |
| | Building Construction | Building Construction | 9/6/2021 | 9/25/2021 | 5 | 19 |
| | Paving | Paving | 9/27/2021 | 9/29/2021 | 5 | 2 |

| Trips and VMT | Phase Name | Trips per Day | Total Trips | | | | | | | Trips per Phase | | | VMT per Phase | | | Fuel Consumption (gallons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trip Length | Vendor Trip Length | Hauling Trip Length | Vendor Vel | Num Days | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trips | Vendor Trips | Hauling Trips | Worker Trips | Vendor Trips | Hauling Trips |
| | Demolition | 8 | 0 | 0 | 10.8 | 7.3 | 20 | LD_Mix | 2 | 16 | 0 | 0 | 173 | 0 | 0 | 6.20 | 0.00 | 0.00 |
| | Grading | 8 | 2 | 8 | 10.8 | 7.3 | 20 | LD_Mix | 1 | 8 | 2 | 8 | 86 | 15 | 160 | 3.10 | 1.75 | 1.33 |
| | Building Construction | 8 | 2 | 0 | 10.8 | 7.3 | 20 | LD_Mix | 19 | 152 | 38 | 0 | 1,642 | 277 | 0 | 58.87 | 33.33 | 0.00 |
| | Paving | 8 | 2 | 0 | 10.8 | 7.3 | 20 | LD_Mix | 2 | 16 | 4 | 0 | 173 | 29 | 0 | 6.20 | 3.51 | 0.00 |

On-site Total Construction VMT (miles)
**2,555**

On-Site Total Fuel Consumption (gallons)
**114**

**Construction Equipment Fuel Calculation**

Source: AQ/GHG Appendix, CalEEMod Output
Tracy Electronic Billboard Project - Construction Only
Date: June 9, 2021

| Construction Schedule | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days |
|---|---|---|---|---|---|---|
| | Demolition | Demolition | 9/1/2021 | 9/3/2021 | 5 | 2 |
| | Grading | Grading | 9/4/2021 | 9/5/2021 | 5 | 1 |
| | Building Construction | Building Construction | 9/6/2021 | 9/25/2021 | 5 | 19 |
| | Paving | Paving | 9/27/2021 | 9/29/2021 | 5 | 2 |

| Construction Equipment | Phase Name | Offroad Equipment Type | Amount | Usage Hours | Horse Power | Load Factor | Number of Days | HP Hours | Diesel Fuel Usage |
|---|---|---|---|---|---|---|---|---|---|
| | Demolition | Concrete/Industrial Saws | 1 | 8 | 81 | 0.73 | 2 | 946.08 | 47.30 |
| | Demolition | Rubber Tired Dozers | 0 | 0 | 247 | 0.4 | 2 | 0.00 | 0.00 |
| | Demolition | Tractors/Loaders/Backhoes | 1 | 6 | 97 | 0.37 | 2 | 430.68 | 21.53 |
| | Demolition | Cranes | 1 | 2 | 231 | 0.29 | 2 | 267.96 | 13.40 |
| | Grading | Bore/Drill Rigs | 1 | 8 | 221 | 0.50 | 1 | 884.00 | 44.20 |
| | Grading | Concrete/Industrial Saws | 1 | 8 | 81 | 0.73 | 1 | 473.04 | 23.65 |
| | Grading | Tractors/Loaders/Backhoes | 1 | 6 | 97 | 0.37 | 1 | 215.34 | 10.77 |
| | Building Construction | Cranes | 2 | 4 | 231 | 0.29 | 19 | 10,182.48 | 509.12 |
| | Building Construction | Forklifts | 2 | 6 | 89 | 0.20 | 19 | 4,058.40 | 202.92 |
| | Building Construction | Tractors/Loaders/Backhoes | 2 | 8 | 97 | 0.37 | 19 | 10,910.56 | 545.53 |
| | Paving | Cement and Mortar Mixers | 1 | 6 | 9 | 0.56 | 2 | 60.48 | 3.02 |
| | Paving | Tractors/Loaders/Backhoes | 1 | 7 | 97 | 0.37 | 2 | 502.46 | 25.12 |

**Construction Equipment Fuel Consumption** **1,446.57 gallons**

Notes:
Equipment assumptions are provided in the CalEEMod output files.
Fuel usage estimate of 0.05 gallons of diesel fuel per horsepower-hour is from the SCAQMD CEQA Air Quality Handbook, Table A9-3E.
South Coast Air Quality Management District. 1993. Air Quality Handbook, Table A9-3E.
Website: http://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook. Accessed May 3, 2021.

**Construction Office Electricity Calculation**

Energy Appendix: CalEEMod Typical Construction Trailer

Typical Construction Trailer - Alameda County, Annual

Date: June 9, 2021

**Mitigated**

| | Electricity Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | kWh/yr | MT/yr | | | |
| General Office Building | 7207.2 | 2.0967 | 9.0000e-005 | 2.0000e-005 | 2.1049 |
| **Total** | | **2.0967** | **9.0000e-005** | **2.0000e-005** | **2.1049** |

kWh/yr = kilowatt hours per year

**Energy by Land Use - Electricity**

| | | |
|---|---|---|
| Annual | 7,207 | kWh/yr |
| **Total Over Construction** | **415** | **kWh** |

Total Construction Schedule

| | |
|---|---|
| Start | 9/1/2021 |
| End | 9/29/2021 |
| Total Calendar Days | 21 |
| Years | 0.06 |

# Digital Billboard Energy Use in California

July 2014


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## 5.2 PER UNIT ENERGY USE

As previously stated, the energy use information provided by manufacturers often lacked specificity around display image content and display brightness. Assuming that all data listed in Table 1 reflect 100% full output displays at maximum brightness (i.e. displaying an image that is 100% white in color), and that the maximum brightness of all displays is equivalent, our research identified a range of **16** to **51 W/sq ft** for a current generation DBB. In order to calculate the annual energy use of a DBB, additional assumptions around typical duty cycles and operating modes are needed. For this report, we assume that a DBB will be operating for 24 hours a day (12 hours daylight, 12 hours nighttime), that the display will operate at full brightness (which is capped at 50% of achievable maximum brightness, due to sign color and content) during the day, and that nighttime operating power will be significantly lower than daytime operating power as reported by manufacturers. Ultimately, ambient light levels as well as customer choice play a major role in how much sign brightness is dimmed at night. For calculations in this report, a value of 40% was used. Table 2 describes the basic assumptions required for calculating the energy use of DBBs.

**TABLE 2. BASIC ASSUMPTIONS FOR CALCULATING THE ENERGY USE OF DBBS**

| Parameter | Assumed Value |
|---|---|
| **Daylight hours** | 12 hours |
| **Nighttime hours** | 12 hours |
| **Daylight operating brightness** | 100% |
| **Nighttime operating brightness** | 40% |
| **Average color of message content**[1] | 50% |

[1] As noted in Section 5.1, designs that contain heavy whites, or light colors, use more energy than those using darker colors or primarily black

The following equation describes how the assumptions presented in Table 2 are used to calculate annual energy use for a typical 14 feet by 48 feet (598 square feet) sign:

$$AEU = \frac{W}{ft^2} * \frac{598 ft^2}{sign} * 50\% * \left(\frac{12 hrs}{1 day} * \frac{365 days}{1 yr} * 100\% + \frac{12 hrs}{1 day} * \frac{365 days}{1 yr} * 40\%\right) * \frac{1 kW}{1000 W}$$

Using these assumptions, DBBs may consume between **29,000** and **94,000 kWh per year**. More manufacturer data on actual LED efficacy by color and brightness level is needed to be able to more effectively estimate the expected energy consumption of these products when installed in the field. These calculations are summarized in Table 3.

**TABLE 3. SUMMARY OF RANGE OF REPORTED DBB ENERGY USAGE METRICS, CONVERTED TO ANNUAL ENERGY USE**

| Reported Energy Use by Metric | Energy Use per Square Foot (W) | Energy Use for 14'x48' Sign (W) | Annual Energy Use (kWh) |
|---|---|---|---|
| **0.14 – 0.2 W/pixel** | 46 – 51 | 20,000 – 30,000 | 85,000 – 94,000 |
| **16 – 20 W/ft²** | 16 – 20 | 10,000 – 12,000 | 29,000 – 37,000 |
| **15,000 W/sign** | 25 | 15,000 | 46,000 |

It should be noted that the energy use estimates presented in this section do not include the energy use of other DBB components beyond the display, such as the computer and the cooling system, because these components contribute a relatively small fraction of total DBB energy use.

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