

Appendix E

Energy

Construction Energy Use
Innovation Park PUD

Phase	Sub-phase	Construction Year	MT of CO ₂ from CalEEMod output			
			On-Site Equipment	Hauling Trips	Vendor Trips	Worker Trips
Demo	Demolition	2022	339.9	70.1	0.0	9.0
Part 1	Demolition	2022	85.0	31.3	0.0	2.3
Part 1	Site Prep	2022	46.8	0.0	0.0	1.5
Part 1	Grading	2022	144.5	459.5	0.0	3.2
Part 1	Grading	2023	68.2	209.5	0.0	1.5
Part 1	Building Construction	2023	272.4	0.0	466.4	541.4
Part 1	Building Construction	2024	303.7	0.0	510.1	588.5
Part 1	Building Construction	2025	302.7	0.0	497.8	572.1
Part 1	Building Construction	2026	30.1	0.0	48.6	55.6
Part 1	Paving	2026	53.1	0.0	0.0	2.2
Part 1	Architectural Coatings	2027	6.8	0.0	0.0	22.6
Part 2	Demolition	2026	85.0	28.4	0.0	2.0
Part 2	Site Prep	2026	46.9	0.0	0.0	1.3
Part 2	Grading	2026	147.2	425.4	0.0	2.8
Part 2	Grading	2027	65.4	184.8	0.0	1.2
Part 2	Building Construction	2027	274.8	0.0	433.5	473.4
Part 2	Building Construction	2028	301.5	0.0	465.8	504.9
Part 2	Building Construction	2029	302.7	0.0	458.4	493.8
Part 2	Building Construction	2030	34.2	0.0	44.8	48.0
Part 2	Paving	2030	63.9	0.0	0.0	1.9
Part 2	Architectural Coatings	2030	6.8	0.0	0.0	19.5
Part 3	Demolition	2030	99.3	26.1	0.0	1.8
Part 3	Site Prep	2030	56.0	0.0	0.0	1.2
Part 3	Grading	2030	176.7	390.1	0.0	2.6
Part 3	Grading	2031	78.5	170.3	0.0	1.1
Part 3	Building Construction	2031	311.5	0.0	401.8	428.4
Part 3	Building Construction	2032	344.3	0.0	437.5	464.4
Part 3	Building Construction	2033	341.7	0.0	428.3	452.8
Part 3	Building Construction	2034	32.9	0.0	40.7	42.9
Part 3	Paving	2034	63.9	0.0	0.0	1.7
Part 3	Architectural Coatings	2034	6.8	0.0	0.0	18.1
Part 4	Demolition	2034	99.3	24.5	0.0	1.6
Part 4	Site Prep	2034	56.0	0.0	0.0	1.1
Part 4	Grading	2034	170.1	353.0	0.0	2.3
Part 4	Grading	2035	85.1	174.3	0.0	1.1
Part 4	Building Construction	2035	308.9	0.0	378.0	397.4
Part 4	Building Construction	2036	344.3	0.0	421.4	443.0
Part 4	Building Construction	2037	343.0	0.0	419.8	441.3
Part 4	Building Construction	2038	34.2	0.0	41.8	44.0
Part 4	Paving	2038	63.9	0.0	0.0	1.7
Part 4	Architectural Coatings	2038	6.8	0.0	0.0	17.9

Source	MT of CO ₂
Total GHG from Diesel use	14,046.4
Total GHG from Gasoline Use	6,115.2
Onsite GHG from diesel use	6,004.4
Onroad GHG from diesel use	8,042.0
Percent onsite diesel	42.7%
Percent onroad diesel	57.3%

Construction Year	CO ₂ Emissions by Year (MT/year)			Fuel Use by Year (gallons/year)			
	Onsite Diesel	Onroad Diesel	Onroad Gasoline	Onsite Diesel	Onroad Diesel	Total Diesel	Onroad Gasoline
2022	616.2	560.9	272.4	60,353.6	54,932.7	115,286.2	31,020.6
2023	340.5	675.9	944.0	33,353.5	66,199.2	99,552.7	107,516.7
2024	303.7	510.1	1,152.1	29,747.5	49,957.9	79,705.4	131,215.6
2025	302.7	497.8	820.3	29,643.0	48,760.3	78,403.3	93,430.9
2026	362.2	502.4	65.3	35,476.5	49,211.5	84,688.0	7,438.5
2027	347.0	618.3	536.8	33,986.1	60,555.8	94,541.9	61,135.2
2028	301.5	465.8	673.2	29,529.4	45,619.3	75,148.8	76,673.8
2029	302.7	458.4	660.5	29,643.0	44,896.3	74,539.3	75,233.1
2030	436.8	461.0	232.7	42,780.7	45,153.3	87,934.0	26,504.0
2031	390.0	572.0	576.8	38,199.2	56,027.1	94,226.3	65,693.8
2032	344.3	437.5	522.3	33,726.5	42,848.6	76,575.2	59,490.9
2033	341.7	428.3	452.8	33,469.1	41,950.2	75,419.3	51,573.1
2034	428.9	418.1	67.8	42,011.0	40,950.0	82,961.1	7,717.9
2035	393.9	552.4	398.5	38,582.7	54,100.1	92,682.7	45,387.7
2036	344.3	421.4	443.0	33,726.5	41,277.7	75,004.2	50,459.7
2037	343.0	419.8	441.3	33,597.8	41,120.1	74,717.9	50,267.1
2038	104.8	41.8	63.6	10,264.6	4,096.3	14,360.9	7,239.5
TOTAL	6,004.4	8,042.0	8,323.4	588,090.8	787,656.5	1,375,747.2	947,998.2
Annual Average	375.3	502.6	520.2	36,755.7	49,228.5	85,984.2	59,249.9

Construction Phase	CO ₂ Emissions by Phase (MT)			Fuel Use by Phase (gallons)			
	Onsite Diesel	Onroad Diesel	Onroad Gasoline	Onsite Diesel	Onroad Diesel	Total Diesel	Onroad Gasoline
Demo	339.9	70.1	9.0	33,291.1	6,870.1	40,161.2	1,026.6
Part 1	1,313.2	2,223.1	1,790.9	128,618.1	217,739.6	346,357.7	203,969.9
Part 2	1,328.2	2,041.1	1,548.9	130,088.0	199,913.6	330,001.6	176,409.4
Part 3	1,511.6	1,894.7	1,414.9	148,046.7	185,572.5	333,619.2	161,154.4
Part 4	1,511.6	1,812.9	1,351.5	148,046.8	177,560.8	325,607.5	153,926.9
TOTAL	6,004.4	8,042.0	6,115.2	588,090.8	787,656.5	1,375,747.2	696,487.1

CO₂ from diesel fuel combustion^a = 10.2 kg of CO₂/gallon of diesel

CO₂ from gasoline fuel combustion^a = 8.78 kg of CO₂/gallon of gasoline

^a Emissions factors per The Climate Registry 2019 Default Emission Factors (Table 2.1 - US Default Factors for Calculating CO₂ Emissions from Combustion of Transport Fuels)

Conversion 1 MT = 1000 kg

CNU Medical Center

Phase	Sub-phase	Construction Year	MT of CO ₂ from CalEEMod output			
			On-Site Equipment	Hauling Trips	Vendor Trips	Worker Trips
1A	Site Prep	2022	80.3	524.6	0.0	2.6
1A	Grading	2022	291.8	0.0	0.0	6.4
1A	Building Construction	2022	227.1	0.0	363.1	247.3
1A	Building Construction	2023	301.3	0.0	465.3	317.7
1A	Building Construction	2024	303.7	0.0	460.0	309.7
1A	Building Construction	2025	61.5	0.0	91.2	60.5
1A	Paving	2025	61.1	0.0	0.0	2.5
1A	Architectural Coatings	2025	7.8	0.0	0.0	13.9
1B	Site Prep	2023	25.1	158.5	0.0	0.8
1B	Grading	2023	141.8	0.0	0.0	3.0
1B	Building Construction	2023	98.5	0.0	104.8	79.6
1B	Building Construction	2024	303.7	0.0	317.0	237.4
1B	Building Construction	2025	119.4	0.0	122.1	90.2
1B	Paving	2025	25.0	0.0	0.0	1.0
1B	Architectural Coatings	2025	3.2	0.0	0.0	4.4
2A	Demolition	2027	27.2	6.5	0.0	0.6
2A	Site Prep	2027	15.1	3.9	0.0	0.4
2A	Grading	2027	20.9	6.8	0.0	0.6
2A	Building Construction	2027	18.6	0.0	7.2	4.3
2A	Building Construction	2028	301.5	0.0	115.4	67.1
2A	Building Construction	2029	124.1	0.0	46.5	26.9
2A	Paving	2029	34.0	0.0	0.0	1.2
2A	Architectural Coatings	2029	4.3	0.0	0.0	1.7
2B	Demolition	2028	51.0	16.7	0.0	1.1
2B	Site Prep	2028	13.4	4.5	0.0	0.4
2B	Grading	2028	16.9	7.3	0.0	0.5
2B	Building Construction	2028	180.9	0.0	44.4	32.5
2B	Building Construction	2029	150.7	0.0	36.3	26.4
2B	Paving	2029	18.0	0.0	0.0	1.1
2B	Architectural Coatings	2029	2.9	0.0	0.0	0.9
2C	Demolition	2024	27.2	7.3	0.0	0.7
2C	Site Prep	2024	13.4	3.7	0.0	0.4
2C	Grading	2024	22.2	7.8	0.0	0.7
2C	Building Construction	2024	29.0	0.0	8.9	14.6
2C	Building Construction	2025	149.6	0.0	44.8	73.0
2C	Paving	2025	14.0	0.0	0.0	0.6
2C	Architectural Coatings	2025	1.7	0.0	0.0	1.5
2D	Demolition	2025	13.6	11.6	0.0	0.7
2D	Demolition	2026	4.2	3.5	0.0	0.2
2D	Site Prep	2026	1.3	1.3	0.0	0.0
2D	Grading	2026	2.5	1.8	0.0	0.1
2D	Building Construction	2026	27.6	0.0	1.0	0.9
2D	Paving	2026	1.4	0.0	0.0	0.1
2D	Architectural Coatings	2026	0.4	0.0	0.0	0.0
2E	Demolition	2027	40.8	10.3	0.0	0.9
2E	Site Prep	2027	10.0	2.6	0.0	0.3
2E	Grading	2027	14.3	4.7	0.0	0.4
2E	Building Construction	2027	216.8	0.0	52.7	32.0
2E	Building Construction	2028	144.9	0.0	34.5	20.8
2E	Paving	2028	19.7	0.0	0.0	1.2
2E	Architectural Coatings	2028	3.2	0.0	0.0	0.8

Source	MT of CO ₂
Total GHG from Diesel use	10,760.84
Total GHG from Gasoline Use	2,208.27
Onsite GHG from diesel use	7,029.28
Onroad GHG from diesel use	3,731.56
Percent onsite diesel	65.3%
Percent onroad diesel	34.7%

Construction Year	CO ₂ Emissions by Year (MT/year)			Fuel Use by Year (gallons/year)			
	Onsite Diesel	Onroad Diesel	Onroad Gasoline	Onsite Diesel	Onroad Diesel	Total Diesel	Onroad Gasoline
2022	599.1	887.7	256.4	58,678.3	86,944.3	145,622.6	29,197.1
2023	566.7	728.7	401.2	55,508.6	71,368.6	126,877.2	45,689.5
2024	699.2	804.6	563.6	68,477.9	78,808.0	147,285.9	64,188.0
2025	456.8	269.8	248.2	44,737.7	26,420.5	71,158.3	28,273.9
2026	37.3	7.5	1.4	3,653.5	737.6	4,391.2	154.2
2027	363.7	94.7	39.5	35,620.8	9,278.6	44,899.4	4,500.1
2028	1,038.2	289.0	168.3	101,689.0	28,304.7	129,993.7	19,169.9
2029	1,047.4	260.9	166.8	102,584.6	25,552.6	128,137.2	18,994.5
2030	810.9	169.5	157.8	79,419.2	16,602.7	96,021.9	17,967.6
2031	1,012.3	160.4	147.3	99,143.9	15,711.1	114,855.0	16,776.3
2032	397.7	58.7	57.9	38,956.4	5,752.3	44,708.8	6,600.1
TOTAL	7,029.3	3,731.6	2,208.3	688,470.0	365,481.1	1,053,951.1	251,511.1
Average Annual	702.9	373.2	220.8	68,847.0	36,548.1	105,395.1	25,151.1

Construction Phase	CO ₂ Emissions by Phase (MT)			Fuel Use by Phase (gallons)			
	Onsite Diesel	Onroad Diesel	Onroad Gasoline	Onsite Diesel	Onroad Diesel	Total Diesel	Onroad Gasoline
1A	1,334.5	1,904.2	960.7	130,703.1	186,506.8	317,210	109,421
1B	716.8	702.4	416.4	70,203.0	68,799.3	139,002	47,431
2A	545.6	186.3	102.9	53,439.1	18,250.4	71,690	11,722
2B	433.9	109.1	62.9	42,500.1	10,690.1	53,190	7,167
2C	257.0	72.5	91.5	25,169.1	7,096.0	32,265	10,416
2D	50.9	19.2	2.1	4,980.9	1,877.1	6,858	235
2E	449.8	104.8	56.4	44,056.4	10,266.9	54,323	6,426
2F	483.5	104.1	74.6	47,355.2	10,200.8	57,556	8,497
3A	455.4	123.9	74.6	44,603.4	12,138.3	56,742	8,502
3B	471.2	88.5	59.9	46,147.6	8,667.1	54,815	6,824
3C	514.0	119.7	160.3	50,340.4	11,720.6	62,061	18,254
3D	257.8	25.9	11.1	25,249.8	2,540.1	27,790	1,263
3E	513.8	47.2	62.0	50,319.1	4,619.4	54,938	7,062
3F	545.2	123.6	72.8	53,402.9	12,108.4	65,511	8,292
TOTAL	7,029.3	3,731.6	2,208.3	688,470.0	365,481.1	1,053,951	251,511

CO₂ from diesel fuel combustion^a = 10.2 kg of CO₂/gallon of diesel

CO₂ from gasoline fuel combustion^a = 8.78 kg of CO₂/gallon of gasoline

^a Emissions factors per The Climate Registry 2019 Default Emission Factors (Table 2.1 - US Default Factors for Calculating CO₂ Emissions from Combustion of Transport Fuels)

Conversion 1 MT = 1000 kg

2F	Demolition	2028	22.1	3.6	0.0	0.5
2F	Site Prep	2028	11.7	2.0	0.0	0.3
2F	Grading	2028	57.2	6.2	0.0	1.0
2F	Building Construction	2028	215.7	0.0	54.5	42.0
2F	Building Construction	2029	153.1	0.0	37.9	29.1
2F	Paving	2029	21.0	0.0	0.0	0.8
2F	Architectural Coatings	2029	2.7	0.0	0.0	0.9
3A	Demolition	2029	34.0	10.9	0.0	0.7
3A	Site Prep	2029	16.7	5.5	0.0	0.4
3A	Grading	2029	27.4	11.5	0.0	0.8
3A	Building Construction	2029	180.9	0.0	53.8	39.6
3A	Building Construction	2030	164.3	0.0	42.3	31.0
3A	Paving	2030	28.9	0.0	0.0	0.9
3A	Architectural Coatings	2030	3.2	0.0	0.0	1.2
3B	Demolition	2029	25.5	4.1	0.0	0.5
3B	Site Prep	2029	16.7	2.7	0.0	0.4
3B	Grading	2029	19.6	4.4	0.0	0.5
3B	Building Construction	2029	215.7	0.0	47.3	34.6
3B	Building Construction	2030	157.7	0.0	30.0	21.8
3B	Paving	2030	32.5	0.0	0.0	1.0
3B	Architectural Coatings	2030	3.4	0.0	0.0	1.0
3C	Demolition	2030	29.8	6.0	0.0	0.5
3C	Site Prep	2030	20.0	4.0	0.0	0.4
3C	Grading	2030	25.0	6.4	0.0	0.6
3C	Building Construction	2030	245.8	0.0	63.3	95.4
3C	Building Construction	2031	157.7	0.0	39.9	59.9
3C	Paving	2031	32.5	0.0	0.0	0.9
3C	Architectural Coatings	2031	3.2	0.0	0.0	2.5
3D	Demolition	2030	21.7	9.6	0.0	0.6
3D	Site Prep	2030	1.8	1.1	0.0	0.0
3D	Grading	2030	5.4	2.7	0.0	0.1
3D	Building Construction	2030	71.3	0.0	4.1	3.3
3D	Building Construction	2031	148.4	0.0	8.4	6.7
3D	Paving	2031	7.7	0.0	0.0	0.3
3D	Architectural Coatings	2031	1.4	0.0	0.0	0.1
3E	Demolition	2031	31.8	4.2	0.0	0.6
3E	Site Prep	2031	16.0	2.1	0.0	0.3
3E	Grading	2031	26.5	4.5	0.0	0.6
3E	Building Construction	2031	245.8	0.0	22.2	35.9
3E	Building Construction	2032	159.0	0.0	14.2	22.8
3E	Paving	2032	31.3	0.0	0.0	0.9
3E	Architectural Coatings	2032	3.3	0.0	0.0	1.0
3F	Demolition	2031	33.8	8.9	0.0	0.6
3F	Site Prep	2031	16.0	4.2	0.0	0.3
3F	Grading	2031	85.1	13.7	0.0	1.2
3F	Building Construction	2031	206.3	0.0	52.2	37.4
3F	Building Construction	2032	178.7	0.0	44.6	31.7
3F	Paving	2032	22.9	0.0	0.0	0.6
3F	Architectural Coatings	2032	2.4	0.0	0.0	0.9

Operational Transportation Use - Innovation Park PUD & CNU Medical Center

Based on EMFAC2021 data for Sacramento County for 2038, for aggregated model years and speed and all vehicle categories

Fuel	VMT (miles/day)	Fuel Use (gal/day)	miles/gal	Project VMT (miles/day)	Project Fuel Use (gallons/day)	Project Fuel Use (gallons/year)	
Diesel	723,462,383	80358865.44	9.002894436	12593	1399	510,547	
Gasoline	12,460,679,492	436537999.1	28.54431806	216895	7599	2,773,472	
Fuel	VMT (miles/day)	Fuel Use (gal/day)	Fuel Use (kWh/100miles)	Project VMT (miles/day)	Project Electricity Use (kWh/day)	Project Electricity Use (kWh/year)	
Electricity	1,385,519,186	0	34	24117	8200	2,992,906	
	VMT (miles/day)	Fuel Use (gal/day)	miles/gal	Project VMT (miles/day)	Project Fuel Use (gallons/day)	Project Fuel Use (gallons/year)	Project Fuel Use (MMBtu/year)
Natural Gas	26,872,221	4608443.556	5.831083873	468	80	29,279	3,762
		Daily Project VMT from traffic data		254,073			
				253072	CalEEMod Oper Output check		

NOTES:

Total Daily VMT for Project (Innovation Park PUD + CNU Medical Center) from project traffic report.

Total Sacramento VMT based on EMFAC2021 data for City and County of Sacramento for 2038, for aggregated model years and speed and all vehicle categories.

EMFAC2021 includes compressed natural gas in terms of diesel gallon equivalents. This is converted into Btu per the U.S. Department of Energy Alternative Fuel Data Center conversion: 1 DGE of CNG = 128,488 Btu. Available at: https://afdc.energy.gov/fuels/equivalency_methodology.html.

Electricity fuel use of 34 kWh/100 miles obtained from USEPA, 2018, Green Power Equivalency Calculator - Calculations and References (<https://www.epa.gov/greenpower/green-power-equivalency-calculator-calculations-and-references>)

Innovation Park PUD & CNU Medical Center
Electricity for Water Use during Operation

Million Gallons Indoor Use by Land Use	Total
General Office Building	82.8772
Hospital	178.408
Day-Care Center	1.28669
Elementary School	7.57979
University/College (4yr)	11.7761
General Heavy Industry	37.2313
Enclosed Parking Structure	0
Enclosed Parking with Elevator	0
Parking Lot	0
City Park	0
Health Club	121.314
Hotel	3.80502
Apartments Mid Rise	142.883
Condo/townhouse	30.883
Congregate Care (Assisted Living)	6.5154
Single Family Housing	20.0023
Strip Mall	24.4587
Total Million Gallons - Indoor	669.0205
Million Gallons Outdoor Use by Land Use	Total
General Office Building	50.7957
Hospital	33.9825
Day-Care Center	3.30862
Elementary School	19.4909
University/College (4yr)	18.4189
General Heavy Industry	0
Enclosed Parking Structure	0
Enclosed Parking with Elevator	0
Parking Lot	0
City Park	8.57867
Health Club	74.354
Hotel	0.422779
Apartments Mid Rise	90.0783
Condo/townhouse	19.4697
Congregate Care (Assisted Living)	4.10754
Single Family Housing	12.6101
Strip Mall	14.9908
Total Million Gallons - Outdoor	350.60851
Total	1019.629

Source: CalEEMod_Annual_WithTraffic.xlsx

From CalEEMod Users Guide, for Sacramento County

Electricity Intensity Factor to supply water	2117	kWhr/Mgal
Electricity Intensity Factor to treat water	111	kWhr/Mgal
Electricity Intensity Factor to distribute water	1272	kWhr/Mgal
Total Electricity Intensity Factor for Water	3500	kWhr/Mgal
Total annual energy use for water	3,568,702 kWhr/year	
	35687.015 MWh/year	

Summary of Construction Energy Use

Innovation Park PUD

Fuel	Source	Gallons	Gallons/year	California Annual Use	Sacramento Annual Use	% California Use Rate	% Sacramento Use Rate
Diesel	Construction	1,375,747	85,984	3,720,338,983	86,864,407	0.002%	0.099%
Gasoline	Construction	696,487	43,530	15,365,000,000	600,000,000	0.0003%	0.007%

CNU Medical Center

Fuel	Source	Gallons	Gallons/year	California Annual Use	Sacramento Annual Use	% California Use Rate	% Sacramento Use Rate
Diesel	Construction	1,053,951	105,395	3,720,338,983	86,864,407	0.002%	0.099%
Gasoline	Construction	251,511	25,151	15,365,000,000	600,000,000	0.0003%	0.007%

Operational Energy Use - Innovation Park PUD & CNU Medical Center

Fuel	Source	Total	Unit	
Electricity	CNU buildings	39,922	megaWatt-hour/year	From Elk Grove analysis, Table 3.5-2
Natural Gas	CNU buildings	118,924	MMBtu/year	From Elk Grove analysis, Table 3.5-2
Diesel	CNU Emergency Generators	89,376	gallons/year	From Elk Grove analysis, Table 3.5-2
Jet-A	Heliport	3,045	gallons/year	From ESA's AEDT analysis of the busy scenario
Electricity	IP PUD buildings	53,661	megaWatt-hour/year	From operational CalEEMod run
Natural Gas	PUD buildings	123,455	MMBtu/year	From operational CalEEMod run
Gasoline	Motor Vehicles	2,773,472	gallons/year	
Diesel	Motor Vehicles	510,547	gallons/year	
Electricity	Motor Vehicles	2,993	megaWatt-hour/year	
Natural Gas	Motor Vehicles	3,762	MMBtu/year	
Electricity	Water Use	35,687	megaWatt-hour/year	

Summary of Operational Energy Use

Electricity	IP PUD + CNU	132,263	MWh/year	
	California - 2019	279,401,880	MWh/year	0.05%
	Sacramento County - 2019	10,828,217	MWh/year	1.2%
Natural Gas	IP PUD + CNU	246,141	MMBtu/year	
	California - 2019	1,315,820,749	MMBtu/year	0.02%
	Sacramento County - 2019	31,178,994	MMBtu/year	0.8%
Gasoline	IP PUD + CNU	2,773,472	gallons/year	
	California - 2019	15,365,000,000	gallons/year	0.02%
	Sacramento County - 2019	600,000,000	gallons/year	0.5%
Diesel	IP PUD + CNU	599,923	gallons/year	
	California - 2019	3,720,338,983	gallons/year	0.02%
	Sacramento County - 2019	86,864,407	gallons/year	0.7%
Jet A fuel	CNU	3,045	gallons/year	
	California	4,460,442,000	gallons/year	0.0001%

Source: State Energy Data System (SEDS): 2019 at https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=CA