CO_2 Sequestration/Greenhouse Gas Emissions Tables

Table 4-1
CO_2 Sequestration Capacity of Removed Vegetation
Vista Canyon
Santa Clarita, California

Vegetation Type[1]	IPCC Designation[2]	IPCC Sub qualification	Tons Dry Matter Carbon/Acre[3]	Sequestered CO_2 / Acre[4]	Total Impacted Area [acres][5]	CO_2 Sequestration Capacity of Removed Vegetation
			[tonne/acre]	[tonne/acre]		[tonne]
Cropland	Cropland		1.9	6.9	0	0
Grassland	Grassland		1.2	4.3	37	158
IPCC - Forest Land - scrub	Forest Land	Scrub	3.9	14.3	30	429
IPCC - Forest Land - trees	Forest Land	Trees	30.4	111.5	6	613
Other	Settlements		-	8.5	19	164
Wetlands	Wetlands		0	0.0	26	0
GRAND TOTAL	-		-	-	**117**	**1,365**

Notes:

1. Land types shown here represent vegetation that will be potentially removed upon development. For the "other" category, sequestered CO_2 per acre was estimated as the average of cropland, grassland and forest land-scrub.
2. Land types are assigned to generalized IPCC Land Designations (IPCC 2006).
3. Dry matter carbon per acre was determined from information contained in Table 4-2.
4. It is conservatively assumed that all carbon is eventually converted into CO_2. Multiply the mass of carbon by 3.67 to calculate the final mass of CO_2 (the molecular mass of CO_2 / the molecular mass of carbon is 44/12 or 3.67).
5. Data provided by Impact Sciences, Inc. in an email to Vista on June 16, 2009.

Sources:

Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines). Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

Table 4-2
Carbon per Acre for IPCC Land Types
Vista Canyon
Santa Clarita, California

IPCC Designation	Sub qualifitication	Above Ground Biomass[1]	Ratio of Above Ground / Below Ground Biomass[2]	Total Biomass	Total Biomass[3]	Tons Dry Matter Carbon/Acre[4]
		[tonne d.m./acre]		[tonne d.m./Hectare]	[tonne d.m./acre]	[tonne/acre]
Cropland[5]		-	-	10	4.0	1.9
Grassland[5]		-	-	6.1	2.5	1.2
Forest Land[6]	Scrub	5.7	2.17	-	8.3	3.9
Forest Land[7]	Trees	52.6	4.35	-	64.7	30.4
Settlements		-	-	-	0.0	0.0
Wetland		-	-	-	0.0	0.0

Notes:

1. Numbers listed are used in conjunction with above ground/below ground ratios to calculate total biomass per acre. Values from source converted to tonne/acre.

2. This value is used to calculate total biomass when data for the total biomass is not available for a particular land type.

3. Total biomass is either 1.) Listed directly in the IPCC protocol, or 2.) Calculated from above ground biomass and the Above Ground / Below Ground biomass ratios as follows: Total = Above + (Above / Ratio). Values from source converted to tonne/acre as necessary.

4. Total biomass multiplied by carbon fraction in plant material (0.47) to calculate carbon content. From IPCC (2006), default value for Forest Land (Table 4.3 of IPCC). Here, it is assumed that agricultural vegetation has the same carbon fraction as other vegetation types.

5. Total biomass for grassland corresponds to IPCC value for grassland in warm temperate-dry climates (Table 6.4 of IPCC).

6. The value for the ratio of above ground/below ground biomass for various scrub types corresponds to the IPCC value for temperate mountain/continental systems (other broadleaf above-ground biomass <75 tonnes/hectare)(Table 4.4 of IPCC, p. 4.49). This value is likely to be conservative since scrub is a type of shrub which is likely to have a smaller ratio than for trees. The value for abov ground biomass applied to various scrub types is based on a value of 1,417 g biomass/m 2 (or 5.7 tonne biomass/acre) for coastal sage scrub (Gray and Schlesinger). It is assumed that all scrub types will have similar values.

7. The value for the ratio of above ground/below ground biomass for forest land for various tree types corresponds to the IPCC value for temperate mountain/continental systems (other broadleaf abo ground biomass 75-150 tonnes/hectare)(Table 4.4 of IPCC, p. 4.49). The value for above ground biomass for forest land corresponds to the IPCC value for temperate mountain/continental systems (North and South America > 20 years)(Table 4.7 of IPCC).

Abbreviations:

d.m - dry mass

Sources:

Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines). Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

Table 4-3
CO_2 Sequestration Capacity of New Tree Plantings
Vista Canyon
Santa Clarita, California

IPCC Tree Species Class Designation	Sequestered CO_2 / Tree[2]	Total Number of Planted Trees[1]	CO_2 Sequestration Capacity of New Trees[3]
Miscellaneous	0.035	2,100	1,470
GRAND TOTAL	-	**2,100**	**1,470**

Notes:

1. Estimated number of trees provided by Vista Canyon Ranch, LLC. Because the number of each type of tree was not specified, average of 0.035 tonne CO_2 per year per tree was assumed.

2. Species class-specific sequestration values are provided in Table 8.2 of "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4". For species that do not appear in Table 8.2, the species was classifed as "miscellaneous" and the average value of all listed data was used.

3. An active growing period of 20 years was assumed for the new trees planted.

Sources:

Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines). Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

Table 4-4
Change in CO_2 Sequestration Due to Vegetation Removal and New Tree Plantings
Vista Canyon
Santa Clarita, California

CO_2 Sequestration Capacity of Removed Vegetation	CO_2 Sequestration Capacity of New Trees	Net Change in CO_2 Sequestration Capacity[1]
[tonne]	[tonne]	[tonne]
1,365	1,470	105

Notes:
1. A positive value represents an increase in sequestration capacity and thus a net reduction in CO_2.

Table 4-5a
GHG Emissions from Construction Equipment: Mass Site Grading Phase
Vista Canyon
Santa Clarita, California

Equipment[1]	Total Equipment hours[2]	Quantity (full-time operation)[3,4]	Physical Quantity[5,6]	Horsepower[7]	Load Factor[7]	Emission Factor[7] (g/bhp-hr)	CO_2 Emissions[10,11] (tonnes)
Scrapers	23,737	28.3	29	313	0.72	568.3	3,040
Crawler Tractors	7,770	9.3	10	147	0.64	568.3	415
Rubber Tired Dozers	4,830	5.8	6	357	0.59	568.3	578
Water Trucks	10,290	12.3	13	189	0.50	568.3	553
Graders	3,643	4.3	5	174	0.61	568.3	220
Tractors/Loaders/Backhoes	1,569	1.9	2	108	0.55	568.3	53
Excavators	1,377	1.6	2	168	0.57	568.3	75
Off Highway Trucks	1,806	2.2	3	479	0.57	568.3	280
On-Highway Trucks[8]	1,094	1.3	2	N/A	N/A	N/A	N/A
Crushing/Processing Equipment	420	0.5	1	142	0.78	568.3	26
Rollers	986	1.2	2	95	0.56	568.3	30
Cranes	85	0.1	1	399	0.43	568.3	8
Bore/Drill Rigs	40	0.05	1	291	0.75	568.3	5
Pavers	11	0.01	1	100	0.62	568.3	0
On-Highway Water Trucks[9]	588	0.7	1	189	0.50	568.3	32
Total	**58,246**	***	**79**	***	***	***	**5,316**

Notes:

1. Equipment inventory provided by Vista Canyon Ranch, LLC.
2. An equipment-hour is defined as one hour of use for a given piece of equipment. Total equipment hours are estimated from data provided by Vista Canyon Ranch, LLC.
3. Quantities are determined by dividing the total equipment hours by the total hours per unit. The total hours for each unit are calculated by multiplying the number of days in the grading period (105) by the number of working hours per day (8).
   The phase duration is estimated from data provided by Vista Canyon Ranch, LLC.
4. Fraction indicates that one unit would not operate full-time.
5. This represents the actual minimum number of units (one of which would not operate full-time). More units may be required if they are not operated for the entire grading phase.
6. The quantity of each equipment type estimated here is based on data provided by Vista Canyon Ranch, LLC. Some quantities were rounded up to account for one non-full-time unit.
7. The values of Horsepower, Load Factor, and Emission Factor of each type of equipment are from OFFROAD 2007 defaults.
8. The emission calculations of on-highway trucks are different from other off-road equipment, and do not involve horsepower or load factor data. ENVIRON assumes that the on-highway trucks are used for soil hauling; these emissions are calculated in Table 4-8.
9. The horsepower and load factor of off-highway water trucks (from OFFROAD2007) are assumed to apply to water trucks running under different road conditions.
10. The CO_2 Emission calculation formula for each piece of equipment (except for on-highway trucks) is:
    CO_2 Emission = Equipment Hours x HP x Load Factor x Emission Factor x Unit Conversion Factor
11. Assume $CO_2 = CO_2e$ because the contribution of CH_4 and N_2O to overall GHG emissions is likely small (< 1% of total CO_2e) from diesel construction equipment.

Table 4-5b
GHG Emissions from Construction Equipment: Paving, Building Construction, and Architectural Coating Phases
Vista Canyon
Santa Clarita, California

Equipment	Total # Equipment[1]	Total Equipment Hours[1,2]	Horsepower[3]	Load factor[3]	Emission Factor[3] (g/bhp-hr)	CO_2 Emissions[4,5] (tonnes)
Cranes	1	8,177	399	0.43	568.3	797
Forklifts	3	24,531	145	0.3	568.3	606
Generator Sets	1	8,177	49	0.74	568.3	169
Pavers	1	457	100	0.62	568.3	16
Paving Equipment	2	914	104	0.53	568.3	29
Rollers	2	914	95	0.56	568.3	28
Tractors/Loaders/Backhoes	3	24,531	108	0.55	568.3	828
Welders	1	8,177	45	0.45	568.3	94
Total	**14**	**75,880**	***	***	***	**2,567**

Notes:

1. These values reflect the total pieces of equipment and total hours of operation of each equipment type during the Paving, Building Construction, and Architectural Coating phases.
2. The equipment-hours for each individual equipment is calculated based on the phase duration. ENVIRON assumes that all equipment operate 8 hours a day and five days a week during the corresponding phase duration.
3. The values of Horsepower, Load Factor, and Emission Factor of each type of equipment are from OFFROAD 2007 defaults.
4. The CO_2 Emission calculation formula for each piece of equipment is:
   CO_2 Emission = Equipment Hours x HP x Load Factor x Emission Factor x Unit Conversion Factor
5. Assume CO_2 = CO_2e because the contribution of CH_4 and N_2O to overall GHG emissions is likely small (< 1% of total CO_2e) from diesel construction equipment.

Abbreviations:

bhp - break horsepower
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
hr - hour

Table 4-6a
GHG Emissions from Worker Commuting
Vista Canyon
Santa Clarita, California

Construction Sub-Phase	# Worker One-Way Trips[1]	Total Worker VMT[2]	EF^{3}_{LDA}		EF_{LDT1}[4]		EF_{LDT2}[4]		CO_2 Emissions[5]		Total CO_2 Emissions[6]	Total CO_2e Emissions[6,7]
			Running	Startup	Running	Startup	Running	Startup	Running	Startup		
		miles/year	(g/mile)	(g/trip)	(g/mile)	(g/trip)	(g/mile)	(g/trip)	tonnes			
Mass site grading	20,790	264,033	342	210	423	254	424	259	101	5	106	111
Building construction	826,791	10,500,245							4,018	193	4,211	4,433
Coating	165,358	2,100,049							804	39	842	887
Paving	686	8,709							3	0	3	4
Total	**1,013,625**	**12,873,035**									5,162	**5,434**

Notes:

1. Worker one-way trips were calculated for all Demolition, Grading and Paving phases as follows:
   a. Number of workers per day = 1.25 x number of equipment per day
   b. One-way trips per worker per day = 2 (one round-trip)
   Worker one-way trips during the building construction phase are calculated based on four general land use categories: multifamily, single-family, commercial/retail/school/recreation and office/industrial. The total one-way trips per day are the sum of the following:
   i. 0.36* # multifamily units
   ii. 0.72 * # single-family units
   iii. 0.32 *(commercial/retail/school/recreation square ft)/1000
   iv. 0.42 * (office/industrial square ft)/1000
   Worker one-way trips for Coating phase are 20% of the worker trips for Building Construction Phase.
2. Vehicle Miles Traveled = Worker one-way trips x 12.7 miles per one-way trip, based on URBEMIS default.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
   The startup emission factor depends on the settling period before driving. The startup emissions were conservatively calculated based on a 12 hour wait before each engine startup.
4. LDT1: up to 6000 GVW; LDT2: up to 8500 GVW
5. GHG Running Emission calculation formula: GHG Emission = VMT x (0.5 x EF_{LDA} + 0.25 x EF_{LDT1} + 0.25 x EF_{LDT2})$_{Running}$
   GHG Startup Emission calculation formula: GHG Emission = Worker Trips x (0.5 x EF_{LDA} + 0.25 x EF_{LDT1} + 0.25 x EF_{LDT2})$_{Startup}$
   URBEMIS 9.2.2 assumes that LDA and LDT have a 50:50 mixing ratio.
6. $CO_2e = CO_2 / 0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their global warming potentials.
7. The emission factor values for 2009 were used for all calculations.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - hydro fluorocarbons
hr - hour
LDA - Light Duty Auto
LDT - Light Duty Truck
RMDP: the Resource Management and Development Plan
SCP: Spineflower Conservation Plan
MPH: miles per hour
N_2O: nitrous oxide
MPH - Miles per hour
URBEMIS - Urban Emissions Model
VMT - Vehicle Miles Traveled

Table 4-6b
GHG Emissions from Worker Commuting: Overlay Option
Vista Canyon
Santa Clarita, California

Construction Sub-Phase	# Worker One-Way Trips[1]	Total Worker VMT[2]	EF^{3}_{LDA}		EF_{LDT1}[4]		EF_{LDT2}[4]		CO_2 Emissions[5]		Total CO_2 Emissions[6]	Total CO_2e Emissions[6,7]
			Running	Startup	Running	Startup	Running	Startup	Running	Startup		
		miles/year	(g/mile)	(g/trip)	(g/mile)	(g/trip)	(g/mile)	(g/trip)	tonnes			
Mass site grading	20,790	264,033	342	210	423	254	424	259	101	5	106	111
Building construction	805,203	10,226,081							3,913	188	4,101	4,317
Coating	161,041	2,045,216							783	38	820	863
Paving	686	8,709							3	0	3	4
Total	**987,720**	**12,544,039**									5,031	**5,295**

Notes:

1. Worker one-way trips were calculated for all Demolition, Grading and Paving phases as follows:
   a. Number of workers per day = 1.25 x number of equipment per day
   b. One-way trips per worker per day = 2 (one round-trip)
   Worker one-way trips during the building construction phase are calculated based on four general land use categories: multifamily, single-family, commercial/retail/school/recreation and office/industrial. The total one-way trips per day are the sum of the following:
   i. 0.36* # multifamily units
   ii. 0.72 * # single-family units
   iii. 0.32 *(commercial/retail/school/recreation square ft)/1000
   iv. 0.42 * (office/industrial square ft)/1000
   Worker one-way trips for Coating phase are 20% of the worker trips for Building Construction Phase.
2. Vehicle Miles Traveled = Worker one-way trips x 12.7 miles per one-way trip, based on URBEMIS default.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
   The startup emission factor depends on the settling period before driving. The startup emissions were conservatively calculated based on a 12 hour wait before each engine startup.
4. LDT1: up to 6000 GVW; LDT2: up to 8500 GVW
5. GHG Running Emission calculation formula: GHG Emission = $VMT \times (0.5 \times EF_{LDA} + 0.25 \times EF_{LDT1} + 0.25 \times EF_{LDT2})_{Running}$
   GHG Startup Emission calculation formula: GHG Emission = Worker Trips x $(0.5 \times EF_{LDA} + 0.25 \times EF_{LDT1} + 0.25 \times EF_{LDT2})_{Startup}$
   URBEMIS 9.2.2 assumes that LDA and LDT have a 50:50 mixing ratio.
6. $CO_2e = CO_2 / 0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their global warming potentials.
7. The emission factor values for 2009 were used for all calculations.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - hydro fluorocarbons
hr - hour
LDA - Light Duty Auto
LDT - Light Duty Truck
MPH: miles per hour
N_2O: nitrous oxide
MPH - Miles per hour
URBEMIS - Urban Emissions Model
VMT - Vehicle Miles Traveled

Table 4-7a
GHG Emissions from Vendor Trips
Vista Canyon
Santa Clarita, California

Construction sub-phase	# Vendor One-Way Trips[1]	Total Vendor VMT[2]	EF^{3}_{HHD}		CO_2 Emissions[4]		Total CO_2e Emissions[5]
			Running	Startup	Running	Startup	
		miles/year	(g/mile)	(g/trip)	tonnes		
Building construction	392,043	3,489,182	1,862	211	6,496	83	**6,579**

Notes:

1. Vendor trips only occur during the building construction phase, and they are calculated based on four general land use categories: multifamily, single-family, commercial/retail/school/recreation and office/industrial. The total one-way trips are the sum of the following:
   i. 0.11* # multifamily units
   ii. 0.11 * # single-family units
   iii. 0.05 *(commercial/retail/school/recreation square ft)/1000
   iv. 0.38 * (office/industrial square ft)/1000
2. Vehicle Miles Traveled = Vendor One-way Trips x 8.9 miles per one-way trip, based on URBEMIS default.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
   The startup emission factor depends on the settling period before driving. The startup emissions are conservatively calculated based on a 12 hour wait before each engine startup.
4. URBEMIS 9.2.4 assumes that all vendors drive heavy-heavy-duty trucks.
   CO_2 Running Emission calculation formula: CO_2 Emission = VMT x $EF_{HHD\text{-}Running}$
   CO_2 Startup Emission calculation formula: CO_2 Emission = Vendor Trips x $EF_{HHD\text{-}Startup}$
5. The emission factor values for 2009 are used for all calculations.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - Hydro Fluorocarbons
HHD - Heavy-Heavy Duty
hr - hour
MPH - Miles per hour
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

Table 4-7b
GHG Emissions from Vendor Trips: Overlay Option
Vista Canyon
Santa Clarita, California

Construction sub-phase	# Vendor One-Way Trips[1]	Total Vendor VMT[2]	EF^{3}_{HHD}		CO_2 Emissions[4]		Total CO_2e Emissions[5]
			Running	Startup	Running	Startup	
		miles/year	(g/mile)	(g/trip)	tonnes		
Building construction	321,137	2,858,118	1,862	211	5,321	68	**5,389**

Notes:

1. Vendor trips only occur during the building construction phase, and they are calculated based on four general land use categories: multifamily, single-family, commercial/retail/school/recreation and office/industrial. The total one-way trips are the sum of the following:
   i. 0.11* # multifamily units
   ii. 0.11 * # single-family units
   iii. 0.05 *(commercial/retail/school/recreation square ft)/1000
   iv. 0.38 * (office/industrial square ft)/1000
2. Vehicle Miles Traveled = Vendor One-way Trips x 8.9 miles per one-way trip, based on URBEMIS default.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
   The startup emission factor depends on the settling period before driving. The startup emissions are conservatively calculated based on a 12 hour wait before each engine startup.
4. URBEMIS 9.2.4 assumes that all vendors drive heavy-heavy-duty trucks.
   CO_2 Running Emission calculation formula: CO_2 Emission = VMT x $EF_{HHD\text{-}Running}$
   CO_2 Startup Emission calculation formula: CO_2 Emission = Vendor Trips x $EF_{HHD\text{-}Startup}$
5. The emission factor values for 2009 are used for all calculations.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - Hydro Fluorocarbons
HHD - Heavy-Heavy Duty
hr - hour
MPH - Miles per hour
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

Table 4-8
GHG Emissions from Soil Hauling Activities
Vista Canyon
Santa Clarita, California

Volume of Imported Earth[1]	# Soil Hauling One-Way Trips[2]	Total Soil Hauling VMT[3]	EF_{HHD}[4]		CO_2 Emissions[5]		Total CO_2e Emissions[6,7]
			Running	Startup	Running	Startup	
(cubic yards)		miles/year	(g/mile)	(g/trip)	tonnes		
500,000	50,000	750,000	1,862	211	1,396	105	**1,502**

Notes:

1. Based on a phone conversation with Glenn Adamick on June 3, 2009.
2. The number of soil hauling trips is calculated assuming 20 cubic yards per round-trip per truck (URBEMIS default). The result is multiplied by two to obtain the number of one-way trips.
3. Soil hauling VMT is calculated assuming 15 miles per one-way trip (URBEMIS default).
4. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH. The startup emission factor depends on the settling period before driving. The startup emissions are conservatively calculated based on a 12 hour wait before each engine startup.
5. URBEMIS 9.2.4 assumes that all demolition haulers drive heavy-heavy-duty trucks.
   CO2 Running Emission calculation formula: CO2 Emission = VMT x $EF_{HHD\text{-}Running}$
   CO2 Startup Emission calculation formula: CO2 Emission = Demolition Hauler Trips x $EF_{HHD\text{-}Startup}$
6. The emission factor values for 2009 are used for all calculations.

Abbreviations:

CH4 - methane
CO2 - carbon dioxide
CO2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - Hydro Fluorocarbons
HHD - Heavy-Heavy Duty
hr - hour
MPH - Miles pe

Table 4-9a
Overall Construction GHG Emissions
Vista Canyon
Santa Clarita, California

Location	Construction Equipment		Worker Commuting	Vendor Trips	Soil Hauling	Total GHG Emissions
	Grading Phase	Paving, Building Construction, and Architectural Coating Phases				
	(tonnes CO_2e)					
Vista Canyon	5,316	2,567	5,434	6,579	1,502	**21,397**

Notes:

1. See previous tables for calculation details. The table includes emissions from construction equipment, soil hauling, worker commuting and vendor trips.

Abbreviations:

CO2e - carbon dioxide equivalent
GHG - Greenhouse Gas

Table 4-9b
Overall Construction GHG Emissions: Overlay Option
Vista Canyon
Santa Clarita, California

Location	Construction Equipment		Worker Commuting	Vendor Trips	Soil Hauling	Total GHG Emissions
	Grading Phase	Paving, Building Construction, and Architectural Coating Phases				
	(tonnes CO_2e)					
Vista Canyon	5,316	2,567	5,295	5,389	1,502	**20,069**

Notes:

1. See previous tables for calculation details. The table includes emissions from construction equipment, soil hauling, worker commuting and vendor trips.

Abbreviations:

CO_2e - carbon dioxide equivalent
GHG - Greenhouse Gas

Table 4-10
CO_2 Emission Factors for Electricity and Natural Gas Usage
Vista Canyon
Santa Clarita, California

Energy Source	Scenario	Source Units	lb CO_2/source unit
Electricity	CARB 2020 NAT emission factor[1]	(kW-hr)	0.631
	2007 emission factor[1]		0.631
	2010 RPS (20%)[2]		0.583
Natural Gas[3]		(MMBTU)	117.0
		(ccf)	12.0

Notes:

1. Emission factor for electricity provided by Southern California Edison for 2007, obtained from the California Climate Action Registry Database. The same emission factor was applied for the CARB 2020 NAT analysis.

2. Estimated emission factor for total energy delivered after implementation of the Renewables Portfolio Standard. Emission factor has been adjusted to reflect 20% of power provided by renewables by multiplying the SCE 2007 emission factor by (1-RPS renewable %) / (1-SCE 2007 renewable %). RPS renewable % is 20% and the SCE 2007 renewable % is 13%.

3. Emission factor for natural gas was obtained from California Climate Action Registry Reporting Protocol, Table C7.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
kW-hr - kilowatt-hour
lb - pound
MMBTU - million british thermal units

Sources:

California Climate Action Registry General Reporting Protocol, Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

California Climate Action Registry Database: Southern California Edison Company 2007 PUP Report. 2008. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Table 4-11
Energy Use per Residential Dwelling Unit: Title-24 Regulated Heating and Cooling
Vista Canyon
Santa Clarita, California

	Electricity Delivered (kW-hr/DU/year)							Natural Gas Delivered (MBTU/DU/yr)						
Type[1]	**Heating[2,3]**	**Cooling[2]**	**RASS Total**	**% Reduction due to 2005 standards relative to 2001[4,5]**	**2005 Estimated Total**	**% Reduction due to 2008 vs. 2005 standards[6]**	**2008 Estimated Total**	**Heating[2,3]**	**Domestic Hot Water[2,7]**	**RASS Total**	**% Reduction due to 2005 standards relative to 2001[4]**	**2005 Estimated Total**	**% Reduction due to 2008 vs. 2005 standards[6]**	**2008 Estimated Total**
Multi-family	120	234	354	24.3%	268	19.7%	215	16.3	15.3	31.6	15.7%	26.6	7%	24.7
Single family	158	956	1,114	19.8%	893	22.7%	690	16.3	22.3	38.6	6.7%	36.0	10%	32.4
Town home[8]	107	479	586	24.3%	444	19.7%	356	16.3	19.8	36.1	15.7%	30.4	7%	28.3

Notes:
1. Based on information provided by Vista Canyon Ranch, LLC.
2. Based on the California Residential Appliance Saturation Survey (RASS), which collected data from over 21,100 households statewide. Only RASS data tabulated for the multifamily homes in the climate zone in which Vista Canyon would be located (Climate Zone 9) were considered in this analysis.
3. Homes can be heated using electricity and/or natural gas. The values shown here are averages for the dataset.
4. Reductions are taken with the assumption that the RASS estimate reflects heating/cooling/hot water electricity use for homes that are minimally compliant with 2001 Title 24 Standards (this version was the most current at the time of the RASS study).
More than 90% of the homes that participated in the survey were constructed before 1997. Because older homes tend to use more energy, the numbers shown here may overestimate actual energy use at a new development such as Vista Canyon.
5. Based on report by California Energy Commission on estimated first-year electricity savings due to 2005 standards for single-family, town homes and multi-family homes, relative to 2001 standards.
6. Based on California Energy Commission report on estimated first-year electricity savings due to 2008 standards for single-family, town homes and multi-family homes, relative to 2005 standards.
7. All domestic hot water systems are assumed to use natural gas.
8. Reductions in Title 24 energy use for multi-family homes were applied to townhomes.

Abbreviations:
DU - Dwelling
kW-hr - kilowatt-hour
MBTU - million British thermal units

Sources:
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF
Kema-Xenergy, Itron, RoperASW. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June 2004. 300-00-004.

Table 4-12
Energy Use per Residential Dwelling Unit: Appliances and Plug-ins
Vista Canyon
Santa Clarita, California

		Electricity Delivered (kW-hr/DU/year)[2]								Natural Gas Delivered (MBTU/DU/yr)[2]		
Type	**Type[1]**	**Refrigerator**	**Clothes Washer**	**Clothes Dryer[3]**	**Dishwasher**	**Cooking Range (Electric)[4]**	**Total Major Appliances**	**MELs**	**Total**	**Clothes Dryer (Gas)[3]**	**Gas Cooking Range[4]**	**Total**
Standard Appliances	**Multi-family**	744	4	93	28	101	971	1,405	2,376	2.1	4.6	6.7
	Single family	1,135	121	242	59	123	1,681	2,181	3,861	2.1	4.6	6.7
	Town home	850	48	189	38	106	1,231	1,666	2,898	2.1	4.6	6.7
Energy Star Appliances[5]	**Multi-family**	633	3	93	17	101	847	1,405	2,252	2.1	4.6	6.7
	Single family	965	90	242	35	123	1,457	2,181	3,637	2.1	4.6	6.7
	Town home	723	36	189	23	106	1,076	1,666	2,743	2.1	4.6	6.7

Notes:
1. Based on information provided by Vista Canyon Ranch, LLC.
2. Energy use per residential dwelling unit is based on information in RASS report.
3. Dryers may be either electric or natural-gas fueled. Only electric dryers are included in this value
4. Cooking ranges can be either gas or electric. This value represents the average of the electricity requirements for the two dryer types.
5. Average energy savings above standard products are applied to refrigeration (15%), clothes washer (25%), dishwasher (40%), and lighting (75%) as reported in Energy Star and Other Climate Protection Partnerships 2006 Annual Report Table 10.

Abbreviations:
DU - Dwelling Unit
kW-hr - kilowatt-hour
MBTU - million british thermal units
MEL - Miscellaneous electric load

Sources:
R. Hendron. Building America Research Benchmark Definition. Technical Report NREL/TP-550-4816. December 2008.
Environmental Protection Agency (USEPA). 2006 Annual Report. Energy Star and Other Climate Protection Partnerships. Available at: http://www.epa.gov/appdstar/pdf/AR%202006%20Final.pdf.
Kema-Xenergy, Itron, RoperASW. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June 2004. 300-00-004.

Table 4-13
Energy Use per Residential Dwelling Unit
Vista Canyon
Santa Clarita, California

		Electricity Delivered					Natural Gas Delivered		
Title 24 Compliance	**Dwelling Type**	**Heating and Cooling**	**Hard Wired Lighting[8]**	**Major Appliances[4,6]**	**Plug-ins[5]**	**Total**	**Heating and Domestic Hot Water**	**Gas Dryers and Oven Ranges[4,6]**	**Total**
		[kW-hr / DU / year]					**(MBTU natural gas / DU / year)**		
Minimally 2005 Title 24 Compliant (CARB 2020 NAT)	Multi-family	268	806	971	1,405	3,450	27	7	33
	Single family	893	1,478	1,681	2,181	6,233	36	7	43
	Town home	444	1,016	1,231	1,666	4,358	30	7	37
Minimally Title 24 Compliant (2008)	Multi-family	215	806	971	1,405	3,397	25	7	31
	Single family	690	1,478	1,681	2,181	6,030	32	7	39
	Town home	356	1,016	1,231	1,666	4,270	28	7	35
20% Better Than 2008 Title 24 and Energy Star Appliances[7]	Multi-family	172	645	847	1,405	3,069	20	7	26
	Single family	552	1,183	1,457	2,181	5,373	26	7	33
	Town home	285	813	1,076	1,666	3,841	23	7	29
Percentage Improvement over 2008 Title 24	Multi-family	20%	20%	13%	0%	10%	20%	0%	16%
	Single family	20%	20%	13%	0%	11%	20%	0%	17%
	Town home	20%	20%	13%	0%	10%	20%	0%	16%

Notess:
1. Information provided by Vista Canyon Ranch, LLC.
2. Energy use shown is from a Title 24 compliant house.
3. Estimated using guidance provided by the US Department of Energy (Table 12 of "Building America Research Benchmark Definition, Updated December 19, 2008").
4. Cooking may be performed on an electric range or a natural gas stove. The values shown in these columns are 50% of the energy/heat used for each stove type.
5. "Plug-ins" refers to electricity use associated with plug-in lighting, plug-in appliances, and miscellaneous electric loads. This energy use is calculated based on the RASS report.
6. Dryers and ovens may be electric or gas. The values presented in this table represent 50% of the electricity and/or natural gas use for each equipment type.
7. Vista Canyon Ranch, LLC has committed to a 20% improvement in energy use in the building envelope over 2008 Title 24 standards and inclusion of energy star appliances.
8. According to the CEC, standards for residential lighting did not change significantly in the 2008 version of Title 24.
9. Hard-wired lighting is assumed to be all outdoor lighting and half of the energy for indoor lighting listed under miscellaneous electricity load in the RASS report. The other indoor lighting is assumed to be plug-ins. Lighting is 60% of the miscellaneous electricity load according to the RASS report.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
BARBD - Building America Research Benchmark Definition
DU - Dwelling Unit
kW-hr - kilowatt-hour

Sources:
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF.

Table 4-14
CO_2e Emissions per Dwelling Unit
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Type	Title-24 Systems[1]		Title-24 Systems and Major Appliances		Title-24 Systems and All MELs		Title-24 Systems	Title-24 Systems and Major Appliances	Title-24 Systems and All MELs
		CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Total	CO_2 Total	CO_2 Total
		(lbs / DU / year)						(tonnes / DU / year)		
Minimally 2005 Title 24 Compliant	**Multi-family**	677	3,114	1,290	3,895	2,177	3,895	1.7	2.4	2.8
	Single family	1,497	4,212	2,557	4,993	3,933	4,993	2.6	3.4	4.0
	Town home	921	3,561	1,698	4,342	2,750	4,342	2.0	2.7	3.2
Minimally Title 24 Compliant (2008)	**Multi-family**	595	2,896	1,161	3,677	1,980	3,677	1.6	2.2	2.6
	Single family	1,264	3,791	2,244	4,572	3,516	4,572	2.3	3.1	3.7
	Town home	800	3,312	1,518	4,093	2,489	4,093	1.9	2.5	3.0
20% Better Than 2008 Title 24 and Energy Star Appliances[5]	**Multi-family**	476	2,316	970	3,098	1,789	3,098	1.3	1.8	2.2
	Single family	1,012	3,033	1,861	3,814	3,132	3,814	1.8	2.6	3.2
	Town home	640	2,649	1,268	3,431	2,239	3,431	1.5	2.1	2.6
Percentage Improvement over 2008 Title 24	**Multi-family**	20%	20%	16%	16%	10%	16%	20%	16%	14%
	Single family	20%	20%	17%	17%	11%	17%	20%	17%	14%
	Town home	20%	20%	16%	16%	10%	16%	20%	16%	14%

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Cod
2. Information provided by Vista Canyon Ranch, LLC.
3. Converted from kW-hr to lb CO_2 using emission factor from the California Climate Action Registry Database: Southern California Edison Company 2007 PUP Report. 2008
4. Converted from MBTU to lb CO_2 using emission factor from California Climate Action Registry General Reporting Protocol (CCAR GRP)
5. Vista Canyon Ranch, LLC has committed to a 20% improvement in energy use in the building envelope over 2008 Title 24 standards and inclusion of energy star appliances.

Abbreviations:
DU - Dwelling Unit
kW-hr - kilowatt-hour
lb - pound
SF - Square Feet

Sources:
2001 Residential Energy Consumption Survey conducted by the US Energy Information Administarion: http://www.eia.doe.gov/emeu/recs/contents.html
California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

California Climate Action Registry Database: Southern California Edison Company 2007 PUP Report. 2008. Available at: Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Table 4-15a
GHG Emissions from Electricity and Natural Gas Usage in Residential Dwelling Units
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	
Minimally 2005 Title 24 Compliant	**Multi-family**	579	1.7	996	**2,148**	2.4	1,362	**2,908**	2.8	1,595	**3,413**
	Single family	106	2.6	274		3.4	363		4.0	429	
	Town Home	432	2.0	878		2.7	1,184		3.2	1,390	
Minimally Title 24 Compliant (2008)	**Multi-family**	579	1.6	917	**1,966**	2.2	1,271	**2,698**	2.6	1,486	**3,165**
	Single family	106	2.3	243		3.1	328		3.7	389	
	Town Home	432	1.9	806		2.5	1,100		3.0	1,290	
20% Better Than 2008 Title 24 and Energy Star Appliances	**Multi-family**	579	1.3	733	**1,572**	1.8	1,068	**2,262**	2.2	1,283	**2,728**
	Single family	106	1.8	194		2.6	273		3.2	334	
	Town Home	432	1.5	645		2.1	921		2.6	1,111	
Percentage Improvement over 2008 Title 24	**Multi-family**	579	20%	20%	**20%**	16%	16%	**16%**	14%	14%	**14%**
	Single family	106	20%	20%		17%	17%		14%	14%	
	Town Home	432	20%	20%		16%	16%		14%	14%	

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Cod
2. Information provided by Vista Canyon Ranch, LLC

Abbreviations:
CO_2 - carbon dioxide
DU - Dwelling Unit
MEL - Miscellaneous electric load
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 4-15b
CO_2 Emissions from Electricity and Natural Gas Usage in Residential Dwelling Units: Overlay Option
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	
Minimally 2005 Title 24 Compliant	**Multi-family**	812	1.7	1,396		2.4	1,910		2.8	2,236	
	Single family	106	2.6	274	**2,549**	3.4	363	**3,456**	4.0	429	**4,055**
	Town Home	432	2.0	878		2.7	1,184		3.2	1,390	
Minimally Title 24 Compliant (2008)	**Multi-family**	812	1.6	1,286		2.2	1,782		2.6	2,084	
	Single family	106	2.3	243	**2,334**	3.1	328	**3,209**	3.7	389	**3,762**
	Town Home	432	1.9	806		2.5	1,100		3.0	1,290	
20% Better Than Title 2008 24 and Energy Star Appliances	**Multi-family**	812	1.3	1,029		1.8	1,498		2.2	1,800	
	Single family	106	1.8	194	**1,868**	2.6	273	**2,692**	3.2	334	**3,245**
	Town Home	432	1.5	645		2.1	921		2.6	1,111	
Percentage Improvement over 2008 Title 24	**Multi-family**	812	20%	20%		16%	16%		14%	14%	
	Single family	106	20%	20%	**20%**	17%	17%	**16%**	14%	14%	**14%**
	Town Home	432	20%	20%		16%	16%		14%	14%	

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Cod
2. Information provided by Vista Canyon Ranch, LLC

Abbreviations:
CO_2 - carbon dioxide
DU - Dwelling Unit
MEL - Miscellaneous electric load
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 4-16a
Categorization of Non-Residential Land Use
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1] (SF)	EIA Building Category[2]	% Area[3]	Total EIA Area[4] (SF)
General Office	646,000	Administrative/professional office	50%	323,000
		Mixed-use office	50%	323,000
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000
Retail - Other than Mall	79,000	Other retail	50%	39,500
		Retail store	50%	39,500
Food Service	39,000	Restaurant/cafeteria	50%	19,500
		Fast food	50%	19,500
Lodging	140,000	Hotel	100%	140,000
Public Assembly	31,000	Entertainment/culture	100%	31,000

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON classifed each Vista Canyon building type the most closely related EIA category.

3. The percentage of each Vista Canyon building type assigned to each of EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly, which represents a movie theater.

4. The product of the area of the Vista Canyon building type and the percentage of each subcategory. The energy use for each building type is presented in the following tables.

Abbreviations:
EIA - Energy Information Administration
CBECS - Commercial Buildings Energy Consumption Survey
SF - Square Feet

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: Building Types Definition: http://www.eia.doe.gov/emeu/cbecs/building_types.html

Table 4-16b
Categorization of Non-Residential Land Use: Overlay Option
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1] (SF)	EIA Building Category[2]	% Area[3]	Total EIA Area[4] (SF)
General Office	396,000	Administrative/professional office	50%	198,000
		Mixed-use office	50%	198,000
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000
Retail - Other than Mall	79,000	Other retail	50%	39,500
		Retail store	50%	39,500
Food Service	39,000	Restaurant/cafeteria	50%	19,500
		Fast food	50%	19,500
Lodging	140,000	Hotel	100%	140,000
Public Assembly	31,000	Entertainment/culture	100%	31,000

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON classifed each Vista Canyon building type the most closely related EIA category.

3. The percentage of each Vista Canyon building type assigned to each of EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly, which represents a movie theater.

4. The product of the area of the Vista Canyon building type and the percentage of each subcategory. The energy use for each building type is presented in the following tables.

Abbreviations:
EIA - Energy Information Administration
CBECS - Commercial Buildings Energy Consumption Survey
SF - Square Feet

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: Building Types Definition: http://www.eia.doe.gov/emeu/cbecs/building_types.html

Table 4-17
End-Uses of Electricity for Non-Residential Building Types
Vista Canyon
Santa Clarita, California

Principal Building Activity	Cooling[1]	Lighting[1]	Office Equipment[2]	Refrigeration[2]	Ventilation[1]	Space Heating[1]	Cooking[2]	Water Heating[1]	Other[2]
All Buildings	26%	23%	18%	9%	7%	5%	2%	1%	9%
Education	26%	26%	20%	4%	7%	5%	1%	1%	10%
Food Sales	14%	13%	17%	44%	4%	2%	2%	1%	4%
Food Service	12%	9%	14%	38%	3%	2%	18%	0%	3%
Health Care	35%	22%	17%	3%	8%	3%	1%	0%	9%
Lodging	28%	23%	7%	6%	7%	11%	1%	5%	13%
Mercantile	25%	22%	20%	10%	7%	7%	1%	1%	8%
Retail (Other than Mall)	24%	25%	19%	6%	7%	7%	1%	1%	9%
Enclosed and Strip Mall	25%	20%	20%	13%	7%	6%	2%	1%	7%
Office	29%	22%	26%	1%	7%	6%	1%	1%	8%
Public Assembly	32%	26%	11%	5%	8%	4%	2%	1%	11%
Public Order and Safety	30%	28%	13%	Q	8%	3%	Q	Q	13%
Religious Worship	38%	26%	5%	2%	10%	5%	(*)	(*)	14%
Service	22%	32%	14%	Q	9%	4%	Q	1%	15%
Warehouse and Storage	15%	38%	9%	4%	13%	3%	Q	1%	18%
Other	31%	27%	18%	Q	9%	Q	Q	1%	11%
Vacant	30%	10%	20%	Q	10%	(*)	Q	Q	30%

Notes:
1. Cooling, Lighting, Ventilation, Space Heating, and Water Heating are included in and regulated by California Title 24.
2. Non-built energy uses such as Office Equipment, Refrigeration, Cooking, and Other are not regulated by California Title 24 but still contribute to energy consumption.

Abbreviations:
Q - data withheld, fewer than 20 buildings sampled.
(*) - value rounds to zero in original units.
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Source:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: Calculated from data from Tables 3a and 3b of:
http://www.eia.doe.gov/emeu/cbecs/enduse_consumption/pba.html

Table 4-18
End-Uses of Natural Gas for Non-Residential Building Types
Vista Canyon
Santa Clarita, California

Principal Building Activity	Space Heating[1]	Cooking[2]	Water Heating[1]	Other[2]
All Buildings	73%	14%	10%	3%
Education	81%	8%	4%	6%
Food Sales	71%	13%	13%	Q
Food Service	42%	17%	39%	Q
Health Care	72%	8%	18%	Q
Lodging	53%	30%	9%	4%
Mercantile	76%	10%	9%	6%
Retail (Other than Mall)	78%	11%	Q	9%
Enclosed and Strip Mall	72%	8%	18%	Q
Office	94%	4%	3%	0%
Public Assembly	82%	9%	7%	Q
Public Order and Safety	79%	9%	Q	Q
Religious Worship	85%	8%	5%	Q
Service	73%	25%	Q	Q
Warehouse and Storage	88%	7%	Q	5%
Other	84%	11%	Q	Q
Vacant	95%	5%	Q	Q

Notes:
1. Cooling, Lighting, Ventilation, Space Heating, and Water Heating are included in and regulated by California Title 24.
2. Non-built energy uses such as Office Equipment, Refrigeration, Cooking, and Other are not regulated by California Title 24 but still contribute to energy consumption.

Abbreviations:
Q - data withheld, fewer than 20 buildings sampled.
(*) - value rounds to zero in original units.
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Source:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: Calculated from data from Table 2 of:
http://www.eia.doe.gov/emeu/cbecs/enduse_consumption/pba.html

Table 4-19
Energy Use for Non-residential Building Types
Vista Canyon
Santa Clarita, California

EIA Building Type	Electricity								Natural Gas							
	Title 24-regulated Uses (2001 Title 24)[1,2]	Title 24-regulated Uses (2005 Title 24)[3]	Title 24-regulated uses (2008 Title 24)[4]	20% Improvement over 2008 Title 24 [5]	Non Title 24-regulated Uses	2005 Total Electricity	2008 Total Electricity	Total Electricity with 20% Improvement Over 2008 Title 24	2001 Title 24-regulated Uses[6,7]	Title 24-regulated Gas Uses (2005 Title 24)[3]	2008 Title 24 gas[4]	20% Improvement over 2008 Title 24 [5]	Non Title 24-regulated Uses	2005 Total Natural Gas Use	2008 Total Natural Gas	Total Natural Gas with 20% Improvement Over 2008 Title 24
	(kW-hr / SF / year)								(ccf / SF / year)							
Administrative/professional office	10.13	9.35	8.90	7.12	5.44	14.80	14.34	12.56	0.15	0.14	0.13	0.10	0.01	0.15	0.13	0.11
Mixed-use office	10.65	9.83	9.35	7.48	5.72	15.55	15.06	13.19	0.10	0.10	0.09	0.07	0.00	0.10	0.09	0.07
Grocery store/food market	17.99	16.60	15.79	12.63	35.98	52.59	51.77	48.61	0.16	0.15	0.14	0.11	0.03	0.18	0.17	0.14
Other retail	13.90	12.83	12.20	9.76	7.73	20.56	19.93	17.49	0.16	0.15	0.14	0.11	0.04	0.20	0.18	0.16
Retail store	6.30	5.82	5.53	4.43	3.51	9.32	9.04	7.93	0.07	0.07	0.07	0.05	0.02	0.09	0.09	0.07
Restaurant/cafeteria	12.12	11.18	10.64	8.51	33.01	44.19	43.64	41.52	1.41	1.37	1.24	0.99	0.33	1.70	1.57	1.32
Fast food	28.65	26.44	25.14	20.12	78.04	104.48	103.18	98.15	1.38	1.34	1.21	0.97	0.32	1.66	1.54	1.30
Hotel	12.84	11.85	11.27	9.02	4.64	16.49	15.91	13.65	0.20	0.19	0.17	0.14	0.12	0.31	0.29	0.26
Entertainment/culture	28.38	26.19	24.91	19.93	11.19	37.38	36.09	31.11	0.05	0.04	0.04	0.03	0.01	0.05	0.05	0.04
% Improvement over 2008 Title 24				**20.0%**								**20.0%**				

Notes:

1. Baseline Data is from the 2003 Commercial Buildings Energy Consumption Survey conducted by the US Energy Information Administration. Electricity use is based upon buildings in the EIA CBECS database from EIA climate zone 4 (includes CA climate zone 9). Electricity use per square foot (electricity intensity) for each building sample was first calculated. The electricity intensities were then averaged taking into account the weighting factor for each building in the survey. ENVIRON assumed that these values represent energy intensities for minimally 2001 Title 24-compliant nonresidential buildings.

2. Includes only Title 24-regulated electricity (cooling, lighting, ventilation, space heating, water heating) and excludes non-built electricity (office equipment, refrigeration, cooking).

3. Title 24 data shown in this table have been adjusted to reflect improvements in Title 24 building codes since 2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards"). ENVIRON used these CEC average savings percentages, which are 7.7% reduction in 2005 for electricity and 3.2% reduction in 2005 for gas.

4. Title 24 data shown in this table have been adjusted to reflect improvements in Title 24 building codes since 2002. CEC discusses average savings for improvements from 2005 to 2008 ("Impact Analysis for 2008 Energy Efficiency Standards"). ENVIRON used these CEC average savings percentages, which are 4.9% reduction in 2008 for electricity and 9.4% reduction in 2008 for gas.

5. Vista has committed to a 20% improvement in Title 24-regulated energy use, relative to minimally 2008 Title 24-compliant buildings.

6. Natural gas use is based upon buildings in the EIA CBECS database from EIA climate zone 4 (includes CA climate zone 4). Natural gas use per square foot (intensity) for each building sample was first calculated. The natural gas intensities were then averaged taking into account the weighting factor for each building in the survey.

7. Includes only Title 24-regulated natural gas (space heating, water heating) and excludes non-built natural gas (cooking, other).

Abbreviations:
CA - California
CBECS - Commercial Building Energy Consumption Survey
CEC - California Energy Commission
EIA - Energy Information Administration
kW-hr - kilowatt-hour
SF - Square Feet
ccf - 100 cubic feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Table 4-20
CO_2 Emissions Per Unit Area From Energy Use in Non-residential Building Types
Vista Canyon
Santa Clarita, California

EIA Building Type	CO_2e Emissions per Square Foot (Tonnes CO_2e/SF/year)[1]								
	2005 Title 24 Compliant			2008 Title 24 Compliant			20% Better than 2008 Title 24[2]		
	Electricity (Total)	Natural Gas (Total)	Total	Electricity (Total)	Natural Gas (Total)	Total	Electricity (Total)	Natural Gas (Total)	Total
Administrative/professional office	4.23E-03	8.05E-04	5.04E-03	3.79E-03	7.32E-04	4.52E-03	3.32E-03	5.92E-04	3.91E-03
Mixed-use office	4.45E-03	5.48E-04	5.00E-03	3.98E-03	4.98E-04	4.48E-03	3.49E-03	4.03E-04	3.89E-03
Grocery store/food market	1.51E-02	9.84E-04	1.60E-02	1.37E-02	9.07E-04	1.46E-02	1.29E-02	7.58E-04	1.36E-02
Other retail	5.88E-03	1.08E-03	6.96E-03	5.27E-03	9.98E-04	6.27E-03	4.62E-03	8.47E-04	5.47E-03
Retail store	2.67E-03	5.10E-04	3.18E-03	2.39E-03	4.73E-04	2.86E-03	2.10E-03	4.01E-04	2.50E-03
Restaurant/cafeteria	1.26E-02	9.27E-03	2.19E-02	1.15E-02	8.57E-03	2.01E-02	1.10E-02	7.22E-03	1.82E-02
Fast food	2.99E-02	9.09E-03	3.90E-02	2.73E-02	8.40E-03	3.57E-02	2.60E-02	7.07E-03	3.30E-02
Hotel	4.72E-03	1.69E-03	6.41E-03	4.21E-03	1.59E-03	5.80E-03	3.61E-03	1.41E-03	5.02E-03
Entertainment/culture	1.07E-02	2.75E-04	1.10E-02	9.54E-03	2.52E-04	9.80E-03	8.23E-03	2.07E-04	8.43E-03

Notes:

1. Data from the 2003 Commercial Buildings Energy Consumption Survey (see Table 4-19) was multipled by electricity and natural gas emission factors (see Table 4-10) to calculate CO_2 emissions intensities.
2. Vista Canyon Ranch, LLC has committed to a 20% improvement over 2008 Title-24 standards.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
SF - Square Feet
RPS - Renewables Portfolio Standard
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:

US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 4-21a
Total GHG Emissions From Energy Use in Non-Residential Building Types
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1]	EIA Building Category[2]	% Area[3]	Related Area[4]	Annual Area Emission Factor			Total Annual CO_2e Emissions							Percent CO_2e Reductions over 2008 Title 24
					2005 Title 24 Compliant (CARB 2020 NAT)	2008 Title 24 Compliant	20% Better than 2008 Title 24	2005 Title 24 Compliant (CARB 2020 NAT)		2008 Title 24 Compliant		20% Better than 2008 Title 24		20% Better than 2008 Title 24 and On-Site Emission Savings[7]	
	(SF)			(SF)	(Tonne CO_2e / SF / year)[5]			(Tonne CO_2e / year)[6]							
General Office	646,000	Administrative/professional office	50%	323,000	5.04E-03	4.52E-03	3.91E-03	1,628		1,461		1,264			
		Mixed-use office	50%	323,000	5.00E-03	4.48E-03	3.89E-03	1,614		1,448		1,257			
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000	1.60E-02	1.46E-02	1.36E-02	241		219		204			
Retail - Other than Mall	79,000	Other retail	50%	39,500	6.96E-03	6.27E-03	5.47E-03	275		248		216			
		Retail store	50%	39,500	3.18E-03	2.86E-03	2.50E-03	126	**6,308**	113	**5,692**	99	**5,003**	**4,652**	**18%**
Food Service	39,000	Restaurant/cafeteria	50%	19,500	2.19E-02	2.01E-02	1.82E-02	427		392		355			
		Fast food	50%	19,500	3.90E-02	3.57E-02	3.30E-02	760		696		644			
Lodging	140,000	Hotel	100%	140,000	6.41E-03	5.80E-03	5.02E-03	897		812		702			
Public Assembly	31,000	Entertainment/culture	100%	31,000	1.10E-02	9.80E-03	8.43E-03	340		304		261			

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON mapped each Vista Canyon building type to an EIA.
3. The percentage of each Vista Canyon building type assigned to each of the EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly.
4. The product of the area of the Vista Canyon building type and the percentage of each subcategory.
5. Emissions per square foot per year as calculated in Table 4-19.
6. Emissions for each building type are calculated as emissions per square foot times square footage.
7. Vista Canyon Ranch, LLC plans to install on-site energy systems that provide greenhouse gas reductions equivalent to the emission savings from 80,000 square feet of solar panels, which is approximately 351 tonnes.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
SF - Square Feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 4-21b
Total CO_2 Emissions From Energy Use in Non-Residential Building Types : Overlay Option
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1]	EIA Building Category[2]	% Area[3]	Related Area[4]	Annual Area Emission Factor			Total Annual CO_2e Emissions							Percent CO_2e Reductions over 2008 Title 24
					2005 Title 24 Compliant	2008 Title 24 Compliant	20% Better than 2008 Title 24	2005 Title 24 Compliant (CARB 2020 NAT)		2008 Title 24 Compliant		20% Better than 2008 Title 24		20% Better than 2008 Title 24 and On-site Emission Savings[7]	
	(SF)			(SF)	(Tonne CO_2e / SF / year)[5]			(Tonne CO_2e / year)[6]							
General Office	396,000	Administrative/professional office	50%	198,000	5.04E-03	4.52E-03	3.91E-03	998		896		775			
General Office	396,000	Mixed-use office	50%	198,000	5.00E-03	4.48E-03	3.89E-03	989		887		771			
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000	1.60E-02	1.46E-02	1.36E-02	241		219		204			
Retail - Other than Mall	79,000	Other retail	50%	39,500	6.96E-03	6.27E-03	5.47E-03	275		248		216			
	79,000	Retail store	50%	39,500	3.18E-03	2.86E-03	2.50E-03	126	**5,054**	113	**4,567**	99	**4,027**	**3,676**	**19%**
Food Service	39,000	Restaurant/cafeteria	50%	19,500	2.19E-02	2.01E-02	1.82E-02	427		392		355			
Food Service	39,000	Fast food	50%	19,500	3.90E-02	3.57E-02	3.30E-02	760		696		644			
Lodging	140,000	Hotel	100%	140,000	6.41E-03	5.80E-03	5.02E-03	897		812		702			
Public Assembly	31,000	Entertainment/culture	100%	31,000	1.10E-02	9.80E-03	8.43E-03	340		304		261			

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON mapped each Vista Canyon Ranch building type to an EIA category.
3. The percentage of each Vista Canyon building type assigned to each of the EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly.
4. The product of the area of the Vista Canyon building type and the percentage of each subcategory.
5. Emissions per square foot per year as calculated in Table 4-20.
6. Emissions for each building type are calculated as emissions per square foot times square footage.
7. Vista Canyon Ranch, LLC plans to install on-site energy systems that provide greenhouse gas reductions equivalent to the emission savings from 80,000 square feet of solar panels, which is approximately 351 tonnes.

Abbreviations:
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
SF - Square Feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 4-22a
Estimated CO_2 Emission Savings from Photovoltaic Systems
Vista Canyon Ranch
Santa Clarita, California

Total Photovoltaic Panel Area[1] (ft^2)	Namplate DC System Power Rating[2] (kW)	Derate Factor[3]	AC System Power Rating (kW)	Average Annual Insolation[4] ($kWh/m^2/day$)	Equivalent Hours of 1-sun Insolation[5] (hours/day)	Annual Solar Energy Generation (kWh/yr)[6]	CO_2 Emission Factor[7] (lbs/kWh)	Annual CO_2 Savings (tonnes)
80,000	800	0.770	616	5.90	5.90	1,326,556	0.583	351

Notes:

1. Vista will install on-site features that provide 351 tonnes of GHG emission reductions, which is equivalent to 80,000 square feet of photovoltaic panels.
2. According to American Solar Energy Society/Cooler Planet, one square foot of photovoltaic panel generates approximately 10 W electric power at 1-sun insolation (i.e., at 1 kW/m^2 solar radiation).
3. This is the default factor from National Renewable Energy Laboratory Photovoltaic system performance calculator, PVWatts. PVWatts estimates annual energy production and cost savings for a crystalline silicon PV system. The derate factor accounts for energy losses due to inefficiencies in the DC-to-AC inverter, wiring and other connections; as well as the effects of shading, weather and soil on system performance. See http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/derate.cgi
4. The amount of solar energy that is received per unit area per day. This value depends on location; the value here was estimated for Santa Clarita zip code 91350 using National Renewable Energy Laboratory Photovoltaic system performance calculator PVWatts, Version 2. ENVIRON assumed that this value represents an annual average.
5. Number of hours per day of 1-sun insolation (1 kW/m^2 x 5.9 h/day = 5.9 kWh/m^2day)
6. DC and AC power ratings are based on 1-sun insolation. Thus, multiplying the power rating by the number of peak-sun hours per year yields the annual energy generated in kWh. This estimate assumes that the efficiency of the photovoltaic panels does not change with daily fluctuations of insolation.
7. SCE emission factor for 2007, corrected to reflect a 20% renewables portfolio as required by the Renewables Portfolio Standard by 2010.

References:

American Solar Energy Society and Cooler Planet. FindSolar Solar Power Calculator. Available at: http://www.findsolar.com/index.php?page=rightforme
California Climate Action Registry Database: Southern California Edison Company 2007 PUP Report. 2008. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx
Masters, Gilbert M. 2004. Renewable and Efficient Electric Power Systems. John Wiley & Sons, Inc.: Hobeken, New Jersey.
National Renewable Energy Laboratory, Renewable Resource Data Center. PVWatts. Available at: http://www.nrel.gov/rredc/pvwatts/. Accessed August 29, 2009.

Table 4-22b

Comparison of Rooftop Greenhouse Gas Mitigation Measures

Vista Canyon

Santa Clarita, California

Roofing Option	Available Area (ft^2)	Electricity Saved ($kwh/ft^2/year$)	Natural Gas Saved ($MMBTU/ft^2/year$)	CO_2 Emission factor $(lb/kwh)^2$	CO_2 Emission factor $(lb/MMBTU)^2$	CO_2 Averted ($lb/ft^2/year$)	Total CO_2 Averted (tonnes $CO_2/year$)[8]
Solar Hot Water (Residential)[1]	4,240	--	0.37	--	117	42.7	82
Solar Hot Water (Commercial) (Replacing natural gas)[3]	See details	--	0.37	--	117	42.7	111
Solar Thermal (water, space heating) (Commercial) (Replacing natural gas)[4]	80,000	--	0.37	--	117	42.7	1,549
Solar Thermal (water, space heating) (Commercial) (Replacing electricity)[5]		53.1	--	0.583	--	31.0	1,124
Cool Roof[6]	80,000	0.297	--	0.583	--	0.16	5.8
Photovoltaic Panels[7]	80,000	16.6	--	0.583	--	9.7	351

Notes

1. Assumes each system covers 40 ft^2 and are installed on 106 single-family homes. Assume 1,000 BTU/ft2/day heat provided by panels, based on report by California Solar Energy Industries Association (2009).
2. Emission factor for natural gas from CCAR GRP. Emission factor for electricity from Southern California Edison, adjusted to reflect 20% renewables under the Renewables Portfolio Standard.
3. This estimate is based on the emissions associated with hot water heating in the non-residential buildings at VC. The total CO_2 emissions associated with non-residential natural gas usage for hot water is 148 tonnes/year. According to Lawrence Berkeley National Laboratory, solar water heaters can reduce water heating needs by up to 75%.
4. This is a rough estimate based on the performance of solar water heating systems (see note 1). Additional research is required to determine feasibility and performance of combined water and space heating systems.
5. Assumes 3,400 kwh/year generated by a 64 ft^2 solar thermal system, according to Solar Rating and Certification Corporation (2001).
6. Cooling energy saved (3.2 $kwh/m^2/year$) from Figure 9 of Levinson and Akbari (2009). Does not account for small heating energy penalty (~1% of cooling energy saved) There are Title 24 cool roof requirements for non-residential buildings.
7. Details on PV analysis are provided in a separate table. Cool roof requirements under Title 24 may apply for certain roof-top PV installations, according to California Energy Commission (2005).
8. Estimates of averted emissions are first approximations only.

Sources:

California Energy Commission. 2005. Blueprint No. 83: Q and A on Cool Roofs. December. Available at: http://www.energy.ca.gov/2005publications/CEC-400-2005-053/CEC-400-2005-053.PDF

California Solar Energy Industries Association. 2009. The Value Proposition of Solar Water Heating In California. January. Available at: http://www.seia.org/galleries/pdf/CALSEIA_Report_SWH_Value_Proposition.pdf

P. Denholm. 2007. The Technical Potential of Solar Water Heating to Reduce Fossil Fuel Use and Greenhouse Gas Emissions in the United States. National Renewable Energy Laboratory Technical Report NREL/TP-640-41157. March. Available at: www.nrel.gov/docs/fy07osti/41157.pdf

R. Levinson and H. Akbari. "Potential benefits of cool roofs on commercial buildings: conserving energy, saving money, and reducing emission of greenhouse gases and air pollutants". Energy Efficiency. Published online March 14, 2009Available at: http://www.springerlink.com/content/9r48k34558240825/fulltext.html.

Solar Rating and Certification Corporation. 2001. Solar Thermal Collector Energy Production. October. Available at: http://www.solar-rating.org/solarfacts/energyproduction20011017.pdf

Table 4-23a
Greenhouse Gas Emissions from Vehicles for the Year 2020
Vista Canyon
Santa Clarita, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Internal	Home Based Work	281	265	0.25	66	24,166	282	91	7	9	16	16
	Home Based Other	484	456	0.25	114	41,619			12	15	27	28
Total Internal Resident Trips		*765*	*721*		0	*65,785*			*19*	*24*	*42*	*45*
External	Home Based Work	1,592	1,501	20	30,014	10,955,268	307	91	3,367	50	3,417	3,597
	Home Based Other	4,354	4,105	6	24,629	8,989,764			2,763	136	2,900	3,052
Total External Resident Trips		*5,945*	*5,606*		0	*19,945,031*			*6,131*	*186*	*6,317*	*6,649*
Total Non-Home Based Trips (offsite)		*1,092*	*1,030*	*6*	6,179	*2,255,496*	307	91	*693*	*34*	*727*	*766*
Totals		**7,802**	**7,356**		61,004	**22,266,313**			**6,843**	**244**	**7,087**	**7,460**

Notes:

1. The trip type distribution is based on data provided by Fehr & Peers. The distribution of internal to external trips for each trip type is the following:

Trip Type	Internal	External	Proportion of Total Home Based Trips
Home Based Work	15%	85%	28%
Home Based Other	10%	90%	72%

2. Total weekday daily one-way trips data was provided by Fehr & Peers.

3. Daily trips were adjusted to account for differences between weekend and weekday traffic, based on a report by Sonoma Technology. The weekend traffic (internal) was assumed to be 80% of weekly capacity. The weekend traffic (external) was assumed to be 80% of weekly capacity. There has been no weekend adjustment made for mode shifts.

4. Trip distances were provided by Fehr & Peers.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for Los Angeles County. Speeds of 35 miles per hour for internal trips and 60 miles per hour for external trips and non-home based trips were used to determine emission factors. A reduction in the emission factor of 20% was taken into account for emission reductions due to Pavley Standards.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

References:

Fehr&Peers. 2009. Draft Transportation Impact Study for Vista Canyon Transit-Oriented Development. May 15.
NCHRP Report 365. 1998. Travel Estimation Techniques for Urban Planning.
Sonoma Technology, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-23b
Greenhouse Gas Emissions from Vehicles for the Year 2020: Overlay Option
Vista Canyon
Santa Clarita, California

Scenario[1]	Number of dwelling units	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[3]
Project	1,117	61,004	22,266,313	6,843	244	7,087	**7,460**
Overlay[2]	1,350	73,729	26,910,942	8,270	295	8,565	**9,016**

Notes:

1. The Project scenario and Overlay scenario differ by the number of dwelling units and square footage of office space.

2. For the overlay option it was assumed that all residential mobile source parameters (vehicle miles traveled per dwelling unit, trip length, trip types) were the same as for the project scenario. The estimate presented in this row was scaled from the project scenario based on the number of dwelling units. Thus, VMT and emissions for the project scenario were multplied by a factor of (1,350/1,117) to generate estimates for the overlay scenario.

3. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

References:

Fehr and Peers. 2009. Draft Transportation Impact Study for Vista Canyon Transit-Oriented Development. May 15.
NCHRP Report 365. 1998. Travel Estimation Techniques for Urban Planning.
Sonoma Technology, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-24
Total GHG Emissions from Buses and Buildings at the Proposed Transit Center Building and Structures
Vista Canyon
Santa Clarita, CA

Land Uses[1]	Area[1]	Existing Area[2,3]	Net New Area	CEUS Building Type[4]	CEUS Area	Electricity Usage[5,6]	Natural Gas Usage[5,7]	CO_2 Emissions [tonnes/yr]		Total CO_2e Emissions[5]
								Electricity	Natural Gas	
	[SF]	[SF]	[SF]		[SF]	[KWh/SF/yr]	[kBTU/SF/yr]	[tonnes/yr]		
Parking Structure Security Office	2,000	--	2,000	Miscellaneous	73,500	11.8	4.32	6	0.5	49
Parking Structure	212,000	145,000	67,000	Miscellaneous		2.2	--	39	--	
Bus Transit Stop	4,500	--	4,500	Miscellaneous		2.2	--	3	--	
Metrolink Platforms	22,400	22,400	0	Miscellaneous		2.2	--	0	--	

Notes:

1. Size of the parking structure security office was provided by Vista Canyon Ranch, LLC. Sizes of the parking structure, the bus transit stop, and the metrolink platforms were estimated from a plot plan of the proposed project sent by Vista Canyon Ranch, LLC.
2. The existing Via Princessa Station lot has approximately 395 parking spaces. The size of the parking area was estimated using Geographical Information Systems (GIS) software and aerial photographs.
3. The existing Via Princessa Station has approximately equivalent platform area to that of the proposed station.
4. The CEUS "Miscellaneous" building category includes automobile parking. ENVIRON assumed that bus stop and train platforms will have the same energy usage rate as the parking structure. The CEUS "All Office" category was applied to the parking structure security office.
5. Usage rates were taken from the 2006 California Commercial End-Use Survey (CEUS), performed by Itron under contract to the California Energy Commission (CEC). ENVIRON used data for Southern California Edison (SCE), Zone 10, which is the sector in which the Vista Canyon development is located.
6. Exterior lighting and "miscellaneous" end uses were considered for the proposed parking structure, bus transit stop and Metrolink platforms, as well as for the existing parkign area and Metrolink Platforms. It was assumed that these structures would not have space conditioning (e.g. heating, cooling, ventilation), interior lighting, cooking, water heating, office equipment, motors, air compressors, or process-related electricity uses.
7. ENVIRON assumed that natural gas is used in the security office of the parking structure only.

Abbreviations:

CEC - California Energy Commission
CEUS - California Commercial End-Use
CO2 - carbon dioxide
CO2e - carbon dioxide equivalent
kWh - kilowatt-hour
GHG - greenhouse gas
kBTU - kilo (1000) British thermal units
RPS - Renewables Portfolio Standard
SCE - Southern California Edison
SF - square feet
tonnes - metric tonnes
yr - year

Reference:

California Commercial End-Use Survey. Perofrmed by Itron, under contract to the California Energy Commission. 2006. Available at: http://www.energy.ca.gov/ceus/. Accessed August 24, 2009.

Table 4-25
GHG Emissions for Municipal Sources
Vista Canyon
Santa Clarita, California

Source[1]	Energy Requirements	Units	Emission Factor	Units	Source Quantity	Units	Total CO_2e Emissions [Tonne CO_2e per year]
Lighting							
Public Lighting[2]	149	kW-hr/capita/yr	0.039	tonne CO_2e/capita/year	3,463	residents (capita)	136
						Public Lighting Total:	**136**
Municipal Vehicles							
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	3,463	residents (capita)	173
						Municipal Vehicles Total:	**173**
Water and Wastewater [13]							
Groundwater Supply and Conveyance (Potable)[4,5]	2,915	kW-hr/million gallons	0.77	tonne / million gallons	31	million gallons/year	24
State Water Project Supply and Conveyance (Potable)[4,6]	9,931	kW-hr/million gallons	2.63	tonne / million gallons	48	million gallons/year	126
Water Treatment (Potable)[7]	111	kW-hr/million gallons	0.03	tonne / million gallons	78	million gallons/year	2
Water Distribution (Potable)[8]	1,272	kW-hr/million gallons	0.34	tonne / million gallons	78	million gallons/year	26
On-site Wastewater Treatment (Indirect Emissions)[9,10]	2,011	kW-hr/million gallons	0.53	tonne / million gallons	133	million gallons/year	70
Recycled Water Distribution (Non-Potable)[11]	2,100	kW-hr/million gallons	0.56	tonne / million gallons	40	million gallons/year	22
Decreasing Potable Water Demand for Others[12]	-4,567	kW-hr/million gallons	-1.21	tonne / million gallons	93	million gallons/year	**-112**
						Water and Wastewater Total:	**159**
						Municipal Sources Total:	**468**

Notes:

1. Public Lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution. GHG emissions attributed to electricity use are calculated using the Southern California Edison carbon-intensity factor.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from Southern California Edison.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. The Castaic Lake Water Agency (CLWA) - Santa Clarita Water Division (SCWD) provides water to Vista Canyon Water supply and conveyance is based on two different sources: State Water Project and local groundwater.
According to the 2008 Water Requirements and Supplies report, 61% of the water supply toVista Canyon is from the State Water Supply, and the remaining 39% is from local groundwater.

5. Emission factor for groundwater supply and conveyance is based on information provided in the 2005 CEC report and the electricity generation emission factor from Southern California Edison.

6. Emission factor for the State Water Project is based on information provided by Wilkinson 2000 and the electricity generation emission factor from Southern California Edison.

7. Emission factor for water treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

8. Emission factor for water distribution is based on a 2006 Navigant Consulting refinement of a CEC study on the energy necessary to distribute 1 million gallons of treated water and the Southern California-specific electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

9. An emission factor of 1,911 kWh/million gallons for wastewater treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. An emission factor of 100 kWh/million gallons is also included to account for the energy used in UV disinfection of wastewater, which is specified in the Engineering Report for the Vista Canyon Water Factory.

10. According to Dexter Wilson Engineering Inc., there will be no direct emissions of methane or nitrous oxide from the wastewater treatment plant.

11. Emission factor for recycled water distribution is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. ENVIRON used the average of the range of emission factors presented in the report.

12. Vista Canyon will make available to other users unused recycled water, offsetting the energy use due to the State Water Project and groundwater which would otherwise supply that water, supply, and conveyance.
Of the ~360,000 gallons/day wastewater that is recycled, 109,000 gallons/day (30%) will be used to supply the non-potable demand at Vista Canyon, leaving the remaining 70% recycled water available for sale.
The energy saved from the sale equals the energy required to supply, treat, and distribute the groundwater and State Water Project water minus the energy required to treat and distribute the recycled water.

13. Source quantities for water and wastewater are based on the Engineering Report for the Vista Canyon Water Factory.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
kW-hr - kilowatt hour
MW-hr - megawatt hour
USEPA - United States Environmental Protection Agency

Sources:

California Climate Action Registry (CCAR) Database. Southern California Edison Annual Emissions Report. 2008.
California Energy Commission. 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.
California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf
Wilkinson, Robert. 2000. Methodology for Analysis of the Energy Intensity of California's Water Systems, and An Assessment of Multiple Potential Benefits through Integrated Water-Energy Efficiency Measures.
Dexter Wilson Engineering, Inc. 2009. Engineering Report for the Vista Canyon Water Factory. July.
CLWA Santa Clarita Water Division. 2008. Water Requirements and Supplies. http://www.clwa.org/about/pdfs/2008WaterRequirementsadSupplies.pdf

Table 4-26a
Estimated Water Deliveries: Overlay Option and Annexation Area
Vista Canyon
Santa Clarita, California

Land Use (units)	Project[1]			Overlay[2,3]			Annexation Area[2,3]		
	Count	Potable Deliveries	Recycled Water Deliveries	Count	Estimated Potable Deliveries	Estimated Recycled Water Deliveries	Count	Estimated Potable Deliveries	Estimated Recycled Water Deliveries
		gallons/day			gallons/day			gallons/day	
Residential - Single Family (dwelling units)	106	27,610	0	106	27,610		150	39,071	
Residential - Multi-Family (dwelling units)	1,011	147,766	0	1,244	181,821		0		
Commercial (square feet)	981,000	39,649	33,775	731,000	29,545	25,168	436,000	17,622	15,011
Landscape[4]	--	0	36,287			36,287	--		
Park[4]	--	0	9,000			9,000	--		
Bank Protection[4]	--	0	29,867			29,867	--		
TOTAL (gallons/day)		**215,026**	**108,929**		**238,976**	**100,322**		**56,693**	**15,011**

Notes:

1. Project data obtained from Dexter Wilson Engineering "Engineering report for the Vista Canyon Water Factory", draft. July 17, 2009.
2. Overlay and annexation area land use data provided by Vista Canyon Ranch, LLC
3. Water deliveries were scaled from the project scenario based on the number of dwelling units or square footage.
4. Water deliveries for these uses in the overlay scenario were assumed to be equal to the project scenario. No informaton on these land uses was available for the annexation area.

Table 4-26b
Estimated Wastewater Flows: Overlay Option and Annexation Area
Vista Canyon
Santa Clarita, California

		Project[1]		Overlay[2,3]		Annexation Area[2,3]	
Land Use	**Units**	**Count**	**Flow, gpd**	**Count**	**Estimated Flow, gpd**	**Count**	**Estimated Flow, gpd**
Residential - Single Family	DU	106	27,560	106	27,560	150	39,000
Residential - Multi-Family	DU	1,011	157,716	1,244	194,064	0	0
Hotel[4]	rooms	200	25,000	200	25,000	0	0
Commercial[4]	sf	6,000	1,200	6,000	1,200	0	0
Theater[4]	sf	31,000	3,875	31,000	3,875	0	0
Retail[4]	sf	124,000	18,600	124,000	18,600	0	0
Office	sf	646,000	129,200	396,000	79,200	436,000	87,200
Total			**363,151**		**349,499**		**126,200**

Notes:
1. Project data obtained from Dexter Wilson Engineering "Engineering report for the Vista Canyon Water Factory", draft.
2. Overlay and annexation area land use data provided by Vista Canyon Ranch, LLC
3. Wastewater flow was scaled from the project scenario based on the number of dwelling units or square footage.
4. Wastewater flow for these uses in the overlay scenario were assumed to be equal to the project scenario. No informaton on these land uses was available for the annexation area.

Table 4-27
GHG Emission from Municipal Sources: Overlay Option
Vista Canyon
Santa Clarita, California

Source[1]	Energy Requirements	Units	Emission Factor	Units	Source Quantity	Units	Total CO_2e Emissions [Tonne CO_2e per year]
Lighting							
Public Lighting[2]	149	kW-hr/capita/yr	0.039	tonne CO_2e/capita/year	4,185	residents (capita)	165
						Public Lighting Total:	**165**
Municipal Vehicles							
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	4,185	residents (capita)	209
						Municipal Vehicles Total:	**209**
Water and Wastewater [13]							
Groundwater Supply and Conveyance (Potable)[4,5]	2,915	kW-hr/million gallons	0.77	tonne / million gallons	34	million gallons/year	26
State Water Project Supply and Conveyance (Potable)[4,6]	9,931	kW-hr/million gallons	2.63	tonne / million gallons	53	million gallons/year	140
Water Treatment (Potable)[7]	111	kW-hr/million gallons	0.03	tonne / million gallons	87	million gallons/year	3
Water Distribution (Potable)[8]	1,272	kW-hr/million gallons	0.34	tonne / million gallons	87	million gallons/year	29
On-site Wastewater Treatment (Indirect Emissions)[9,10]	2,011	kW-hr/million gallons	0.53	tonne / million gallons	128	million gallons/year	68
Recycled Water Distribution (Non-Potable)[11]	2,100	kW-hr/million gallons	0.56	tonne / million gallons	37	million gallons/year	20
Decreasing Potable Water Demand for Others[12]	-4,567	kW-hr/million gallons	-1.21	tonne / million gallons	91	million gallons/year	**-110**
						Water and Wastewater Total:	**176**
						Municipal Sources Total:	**550**

Notes:

1. Public Lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution. GHG emissions attributed to electricity use are calculated using the Southern California Edison carbon-intensity factor.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from Southern California Edison.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. The Castaic Lake Water Agency (CLWA) - Santa Clarita Water Division (SCWD) provides water to Vista Canyon Ranch. Water supply and conveyance is based on two different sources: State Water Project and local groundwater. According to the 2008 Water Requirements and Supplies report, 61% of the water supply to Vista Canyon Ranch is from the State Water Supply, and the remaining 39% is from local groundwater.

5. Emission factor for groundwater supply and conveyance is based on information provided in the 2005 CEC report and the electricity generation emission factor from Southern California Edison.

6. Emission factor for the State Water Project is based on information provided by Wilkinson 2000 and the electricity generation emission factor from Southern California Edison.

7. Emission factor for water treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

8. Emission factor for water distribution is based on a 2006 Navigant Consulting refinement of a CEC study on the energy necessary to distribute 1 million gallons of treated water and the Southern California-specific electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

9. An emission factor of 1,911 kWh/million gallons for wastewater treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. An emission factor of 100 kWh/million gallons is also included to account for the energy used in UV disinfection of wastewater, which is specified in the Engineering Report for the Vista Canyon Water Factory.

10. According to Dexter Wilson Engineering Inc., there will be no direct emissions of methane or nitrous oxide from the wastewater treatment plant.

11. Emission factor for recycled water distribution is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. ENVIRON used the average of the range of emission factors presented in the report.

12. Vista Canyon will make available to other users unused recycled water, offsetting the energy use due to the State Water Project and groundwater which would otherwise supply that water, supply, and conveyance. Of the ~360,000 gallons/day wastewater that is recycled, 109,000 gallons/day (30%) will be used to supply the non-potable demand at Vista Canyon, leaving the remaining 70% recycled water available for sale. The energy saved from the sale equals the energy required to supply, treat, and distribute the groundwater and State Water Project water minus the energy required to treat and distribute the recycled water.

13. Source quantities for water and wastewater are based on the Engineering Report for the Vista Canyon Water Factory.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
kW-hr - kilowatt hour
MW-hr - megawatt hour
USEPA - United States Environmental Protection Agency

Sources:

California Climate Action Registry (CCAR) Database. Southern California Edison Annual Emissions Report. 2008.
California Energy Commission. 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.
California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives. October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissi
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf
Wilkinson, Robert. 2000. Methodology for Analysis of the Energy Intensity of California's Water Systems, and An Assessment of Multiple Potential Benefits through Integrated Water-Energy Efficiency Measures.
Dexter Wilson Engineering, Inc. 2009. Engineering Report for the Vista Canyon Water Factory. July.
CLWA Santa Clarita Water Division. 2008. Water Requirements and Supplies. http://www.clwa.org/about/pdfs/2008WaterRequirementsadSupplies.pdf

Table 4-28
GHG Emissions from Area Sources-Landscape Equipment Fuel Combustion
Vista Canyon
Santa Clarita, California

Land Use Type	Quantity[1]	CO_2 emission factor[2]	Equipment Use Period[3]	Annual CO_2 emission
	(units)	(lbs/unit/day)	(days/year)	(tonne/year)
Single-family residential (DU)[4]	106	0.07	180	0.6
Landscape Equipment Fuel Combustion Total				**0.6**

Notes:
1. Land use information provided by Vista Canyon Ranch, LLC.
2. Emission factors provided by URBEMIS, based on estimates using CARB's OFFROAD2007 model.
3. Use period is assumed to be equal to the summer period of 180 days.
4. Based on estimates using the URBEMIS model, emissions from landscaping are mainly attributed to single-family residential land uses; the total acreage of non-residential land uses did not significantly impact the total landscaping CO_2 emissions. Thus, only landscaping emissions associated with single-family residences are calculated here.

Abbreviations:
DU = dwelling unit

Sources:

South Coast Air Quality Management District. Software User's Guide: URBEMIS 2007 9.2.4 for Windows. Prepared by Jones & Stokes Associates. November. Available at: http://www.aqmd.gov/CEQA/urbemis.html

Table 4-29
Greenhouse Gas (GHG) Emissions from Energy Use for Private Swimming Pools
Vista Canyon
Santa Clarita, California

Annual Energy Use Per Pool[1,2,3] (kWh/yr)	Emission Factor[4] (lb CO_2e/kWh)	Total Emissions Per Pool (tonnes CO_2 / yr)	Total Emissions for Six Pools (tonnes CO_2 / yr)
1,512	0.583	0.40	2

Notes:

1. According to Vista Canyon Ranch, LLC, there may be up to six private swimming pools at Vista Canyon.

2. According to Vista Canyon Ranch, LLC, any pools at Vista Canyon will be solar-heated. ENVIRON assumed that all pool energy use is associated with the pool pump, and no electricity or natural gas would be used for pool heating.

3. Annual pool pump use was estimated as the annual California average provided in a 2004 Davis Energy study (2,600 kWh/year) minus the estimated savings from the 2008 Appliance Efficiency Standards (1,088 kWh/year), according to a 2008 study by Davis Energy.

4. 2007 emission factor for electricity is provided by Southern California Edison, obtained from the California Climate Action Registry Database. The emission factor has been adjusted to reflect 20% renewables, which is required by 2010 under RPS.

Abbreviations:
CO_2 = carbon dioxide
kW-hr = kilowatt-hour
RPS = Renewables Portfolio Standard
yr = year

Sources:

California Climate Action Registry General Reporting Protocol, Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

California Climate Action Registry Database: Southern California Edison Company 2007 PUP Report. 2008. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Davis Energy Group. 2004 Analysis of Standards Options For Residential Pool Pumps, Motors, and Controls. Prepared for Pacific Gas and Electric Company. Available at: http://consensus.fsu.edu/FBC/Pool-Efficiency/CASE_Pool_Pump.pdf. Accessed September 3, 2009.

Davis Energy Group. 2008. Proposal Information Template for Residential Pool Pump Measure Revisions. Prepared for Pacific Gas and Electric Company. Available at: http://www.energy.ca.gov/appliances/2008rulemaking/documents/2008-05-15_workshop/other/PGE_Updated_Proposal_Information_Template_for_Residential_Pool_Pump_Measure_Revisions.pdf. Accessed September 3, 2009.

Table 4-30
GHG Emissions from Electricity and Natural Gas Usage in Residential Dwelling Units: Annexation Area
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems		Title-24 Systems and Major Appliances		Title-24 Systems and All MELs	
			CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)
Minimally Title 24 Compliant (2008)	**Single family**	150	2.3	**344**	3.1	**464**	3.7	**550**

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Vista Canyon Ranch, LLC.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2 - carbon dioxide
DU - Dwelling Unit
GHG - greenhouse gas
MEL - Miscellaneous electric loads
RPS - Renewable Portfolio Standards

Sources:

California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 4-31
Total GHG Emissions From Energy Use in Non-Residential Building Types : Annexation Area
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1]	EIA Building Category[2]	% Area[3]	Related Area[4]	Annual Area Emission Factor		Total Annual CO_2e Emissions			
					2005 Title 24 Compliant (CARB 2020 NAT)	2008 Title 24 Compliant	2005 Title 24 Compliant (CARB 2020 NAT)		2008 Title 24 Compliant	
	(SF)			(SF)	(Tonne CO_2e / SF / year)[5]		(Tonne CO_2e / year)[6]			
General Office	436,000	Administrative/professional office	50%	218,000	5.36E-03	4.52E-03	1,169	**2,332**	986	**1,963**
		Mixed-use office	50%	218,000	5.34E-03	4.48E-03	1,163		977	

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON mapped each Vista Canyon building type to an EIA.
3. The percentage of each Vista Canyon building type assigned to each of the EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly.
4. The product of the area of the Vista Canyon building type and the percentage of each subcategory.
5. Emissions per square foot per year as calculated in Table 4-20.
6. Emissions for each building type are calculated as emissions per square foot times square footage.
7. Vista Canyon Ranch, LLC plans to install on-site mitigation systems that provide greenhouse gas reductions equivalent to the emission savings from 80,000 square feet of solar panels.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
GHG - greenhouse gas
SF - Square Feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 4-32
Greenhouse Gas Emissions from Vehicles for the Year 2020: Annexation Area
Vista Canyon
Santa Clarita, California

Scenario[1]	Number of dwelling units	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[3]
Internal	Home Based Work	66	24,166	7	9	16	16
	Home Based Other	114	41,619	12	15	27	28
Total Internal Resident Trips		*0*	*65,785*	*19*	*24*	*42*	*45*
External	Home Based Work	30,014	10,955,268	3,367	50	3,417	3,597
	Home Based Other	24,629	8,989,764	2,763	136	2,900	3,052
Total External Resident Trips		*0*	*19,945,031*	*6,131*	*186*	*6,317*	*6,649*
Total Non-Home Based Trips (offsite)		*6,179*	*2,255,496*	*693*	*34*	*727*	*766*
Project	1,117	61,004	22,266,313	6,843	244	7,087	**7,460**
Annexation Area[2]	150	8,192	2,990,105	919	33	952	**1,002**

Notes:

1. The Project scenario and Annexation area differ by the number of dwelling units and square footage of office space.

2. For the Annexation area it was assumed that all residential mobile source parameters (vehicle miles traveled per dwelling unit, trip length, trip types) were the same as for the project scenario. The estimate presented in this row were scaled from the project scenario based on the number of dwelling units. Thus, VMT and emissions for the project scenario were multiplied by a factor of (150/1117) to generate estimates for the Annexation area.

3. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

References:

Fehr&Peers. 2009. Draft Transportation Impact Study for Vista Canyon Transit-Oriented Development. May 15.
NCHRP Report 365. 1998. Travel Estimation Techniques for Urban Planning.
Sonoma Technology, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-33
GHG Emissions for Municipal Sources: Annexation Area
Vista Canyon
Santa Clarita, California

Source[1]	Energy Requirements	Units	Emission Factor	Units	Source Quantity	Units	Total CO_2e Emissions [Tonne CO_2e per year]
Lighting							
Public Lighting[2]	149	kW-hr/capita/yr	0.039	tonne CO_2e/capita/year	465	residents (capita)	18
						Public Lighting Total:	**18**
Municipal Vehicles							
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	465	residents (capita)	23
						Municipal Vehicles Total:	**23**
Water and Wastewater [12]							
Groundwater Supply and Conveyance (Potable)[4,5]	2,915	kW-hr/million gallons	0.77	tonne / million gallons	8	million gallons/year	6
State Water Project Supply and Conveyance (Potable)[4,6]	9,931	kW-hr/million gallons	2.63	tonne / million gallons	13	million gallons/year	33
Water Treatment (Potable)[7]	111	kW-hr/million gallons	0.03	tonne / million gallons	21	million gallons/year	1
Water Distribution (Potable)[8]	1,272	kW-hr/million gallons	0.34	tonne / million gallons	21	million gallons/year	7
Wastewater Treatment (Indirect Emissions)[9,10]	2,011	kW-hr/million gallons	0.53	tonne / million gallons	46	million gallons/year	24
Recycled Water Distribution (Non-Potable)[11]	2,100	kW-hr/million gallons	0.56	tonne / million gallons	5	million gallons/year	3
						Water and Wastewater Total:	**74**
						Municipal Sources Total:	**116**

Notes:

1. Public Lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution. GHG emissions attributed to electricity use are calculated using the Southern California Edison carbon-intensity factor.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from Southern California Edison.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. The Castaic Lake Water Agency (CLWA) - Santa Clarita Water Division (SCWD) provides water to Vista Canyon Water supply and conveyance is based on two different sources: State Water Project and local groundwater.

According to the 2008 Water Requirements and Supplies report, 61% of the water supply toVista Canyon is from the State Water Supply, and the remaining 39% is from local groundwater.

5. Emission factor for groundwater supply and conveyance is based on information provided in the 2005 CEC report and the electricity generation emission factor from Southern California Edison.

6. Emission factor for the State Water Project is based on information provided by Wilkinson 2000 and the electricity generation emission factor from Southern California Edison.

7. Emission factor for water treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

8. Emission factor for water distribution is based on a 2006 Navigant Consulting refinement of a CEC study on the energy necessary to distribute 1 million gallons of treated water and the Southern California-specific electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

9. An emission factor of 1,911 kWh/million gallons for wastewater treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. An emission factor of 100 kWh/million gallons is also included to account for the energy used in UV disinfection of wastewater, which is specified in the Engineering Report for the Vista Canyon Water Factory.

10. According to Dexter Wilson Engineering Inc., there will be no direct emissions of methane or nitrous oxide from the wastewater treatment plant.

11. Emission factor for recycled water distribution is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. ENVIRON used the average of the range of emission factors presented in the report.

12. Source quantities for water and wastewater are based on the Engineering Report for the Vista Canyon Water Factory.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
kW-hr - kilowatt hour
MW-hr - megawatt hour
USEPA - United States Environmental Protection Agency

Sources:

California Climate Action Registry (CCAR) Database. Southern California Edison Annual Emissions Report. 2008.
California Energy Commission. 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.
California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf
Wilkinson, Robert. 2000. Methodology for Analysis of the Energy Intensity of California's Water Systems, and An Assessment of Multiple Potential Benefits through Integrated Water-Energy Efficiency Measures.
Dexter Wilson Engineering, Inc. 2009. Engineering Report for the Vista Canyon Water Factory. July.
CLWA Santa Clarita Water Division. 2008. Water Requirements and Supplies. http://www.clwa.org/about/pdfs/2008WaterRequirementsadSupplies.pdf

Table 4-34
GHG Emissions from Area Sources-Landscape Equipment Fuel Combustion: Annexation Area
Vista Canyon
Santa Clarita, California

Land Use Type	Quantity[1]	CO_2 emission factor[2]	Equipment Use Period[3]	Annual CO_2 emission
	(units)	(lbs/unit/day)	(days/year)	(tonne/year)
Single-family residential (DU)[4]	150	0.07	180	0.9
Landscape Equipment Fuel Combustion Total				**0.9**

Notes:

1. Land use information provided by Vista Canyon Ranch, LLC.
2. Emission factors provided by URBEMIS, based on estimates using CARB's OFFROAD2007 model.
3. Use period is assumed to be equal to the summer period of 180 days.
4. Based on estimates using the URBEMIS model, emissions from landscaping are mainly attributed to single-family residential land uses; the total acreage of non-residential land uses did not significantly impact the total landscaping CO_2 emissions. Thus, only landscaping emissions associated with single-family residences are calculated here.

Abbreviation:

DU = dwelling unit

Source:

South Coast Air Quality Management District. Software User's Guide: URBEMIS 2007 9.2.4 for Windows. Prepared by Jones & Stokes Associates. November. Available at: http://www.aqmd.gov/CEQA/urbemis.html

Table 4-35
Summary of Greenhouse Gas Emissions for Vista Canyon
Vista Canyon
Santa Clarita, California

Source	GHG Emissions		Percentage of Annual CO_2e Emissions[7] (%)
Vegetation[1]	tonnes CO_2e total	-105	NA
Construction (Worker commuting and vendor trips)[2]		12,013	NA
Construction (All other construction activities)[2]		9,384	NA
Total (one time emissions)		**21,292**	NA
Residential[3]	tonnes CO_2e / year	2,728	18%
Non-Residential[4]		4,652	30%
Mobile[5]		7,460	49%
Municipal[6]		468	3%
Area		1	0.004%
Transit Center[9]		49	0.3%
Swimming Pools[10]		2	0.02%
Total (annual emissions)		**15,360**	NA
Annualized Total[8]	**tonnes CO_2e / year**	**15,892**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the removal of existing vegetation and planting of new vegetation. The emissions are estimated assuming that all carbon currently sequestered in the biomass of the vegetation is released to the atmosphere upon removal of the vegetation. A negative value means a net decrease in emissions. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period 2009-2013. Emissions are calculated using URBEMIS default values, EMFAC2007 and engineering judgment. Sources of emissions include construction equipment (on-site activities and soil hauling) and vehicles associated with worker commuting and vendor trips (non-building emissions).

3. Residential emissions for single family and apartment dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from California Residential Appliance Saturation Survey (RASS). As specified in the , a total of 1117 dwelling units are considered.

4. Non-Residential emissions account for electricity and natural gas use, minus emissions saved by on-site power generation. Vista will install on-site features that provide 351 tonnes of GHG emission reductions, which is equivalent to 80,000 square feet of photovoltaic panels. Emissions estimates for non-residential buildings were developed from the 2006 Commercial End Use Survey (CEUS), published by the California Energy Commission.

5. Mobile source emissions were calculated using VMT estimate prepared by Fehr & Peers. Mobile source emissions account for residential trips. CO2 emissions were scaled to reflect CO2e emissions based on data from the US Environmental Protection Agency (USEPA).

6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on "Refining Estimates of Water-Related Energy Use in California (PIER Final Project Report)", prepared by Navigant Consulting, Inc. (CEC-500-2006-118, December 2006) Emissions from street lighting and municipal vehicles were based upon studies of other cities.

7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.

8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, 40 years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

9. Transit center emissions include indirect emissions from energy use for structures (parking structure, rail platforms, bus station). Because this center will replace an existing Metrolink station, it was assumed there would be no net new emissions associated with Metrolink train service.
10. Swimming pool emissions are indirect emissions resulting from electricity and natural gas use for the pool filtering and heating systems.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
N_2O - nitrous oxide
TBD - to be determined
URBEMIS - Urban Emissions Model

Table 4-36
Summary of Greenhouse Gas Emissions for Vista Canyon : Overlay Option
Vista Canyon
Santa Clarita, California

Source	GHG Emissions		Percentage of Annual CO_2e Emissions[7] (%)
Vegetation[1]	tonnes CO_2e total	-105	NA
Construction (Worker commuting and vendor trips)[2]		10,684	NA
Construction (All other construction activities)[2]		9,384	NA
Total (one time emissions)		**19,963**	NA
Residential[3]	tonnes CO_2e / year	3,245	20%
Non-Residential[4]		3,676	22%
Mobile[5]		9,016	55%
Municipal[6]		550	3%
Area		1	0.004%
Transit Center[9]		49	0.3%
Swimming Pools[10]		2	0.01%
Total (annual emissions)		**16,539**	NA
Annualized Total[8]	**tonnes CO_2e / year**	**17,038**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the removal of existing vegetation and planting of new vegetation. The emissions are estimated assuming that all carbon currently sequestered in the biomass of the vegetation is released to the atmosphere upon removal of the vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period 2009-2013. Emissions are calculated using URBEMIS default values, EMFAC2007 and engineering judgment. Sources of emissions include construction equipment (on-site activities and soil hauling) and vehicles associated with worker commuting and vendor trips (non-building emissions).

3. Residential emissions for single family and apartment dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from California Residential Appliance Saturation Survey (RASS). As specified by Vista Canyon Ranch, LLC, a total of 1350 dwelling units are considered.

4. Non-Residential emissions account for electricity and natural gas use, minus emissions saved by on-site power generation. Vista will install on-site features that provide 351 tonnes of GHG emission reductions, which is equivalent to 80,000 square feet of photovoltaic panels. Emissions estimates for non-residential buildings were developed from the 2006 Commercial End Use Survey (CEUS), published by the California Energy Commission.

5. Mobile source emissions were calculated using VMT estimate prepared by Fehr & Peers. Mobile source emissions account for residential trips. CO2 emissions were scaled to reflect CO2e emissions based on data from the US Environmental Protection Agency (USEPA).

6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on "Refining Estimates of Water-Related Energy Use in California (PIER Final Project Report)", prepared by Navigant Consulting, Inc. (CEC-500-2006-118, December 2006) Emissions from street lighting and municipal vehicles were based upon studies of other cities.

7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.

8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, 40 years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

9. Transit center emissions include indirect emissions from energy use for structures (parking structure, rail platforms, bus station). Because this center will replace an existing Metrolink station, it was assumed there would be no net new emissions associated with Metrolink train service.
10. Swimming pool emissions are indirect emissions resulting from electricity and natural gas use for the pool filtering and heating systems.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 4-37
Summary of Greenhouse Gas Emissions for Vista Canyon: Annexation Area
Vista Canyon
Santa Clarita, California

Source	GHG Emissions		Percentage of Annual CO_2e Emissions (%)
Residential[1]	tonnes CO_2e / year	550	15%
Non-Residential[2]		1,963	54%
Municipal[3]		116	3%
Area		1	0.024%
Mobile		1,002	28%
Total (annual emissions)		**3,632**	NA

Notes:

1. Residential emissions for single family dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from California Residential Appliance Saturation Survey (RASS). A total of 150 dwelling units are considered.

2. Non-Residential emissions account for electricity and natural gas use, minus emissions saved by on-site power generation. Emissions estimates for non-residential buildings were developed from the 2006 Commercial End Use Survey (CEUS), published by the California Energy Commission.

3. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on "Refining Estimates of Water-Related Energy Use in California (PIER Final Project Report)", prepared by Navigant Consulting, Inc. (CEC-500-2006-118, December 2006) Emissions from street lighting and municipal vehicles were based upon studies of other cities.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
N_2O - nitrous oxide
TBD - to be determined
URBEMIS - Urban Emissions Model

Table 5-1
GHG Emissions in Context: Supporting Calculations
Vista Canyon
Santa Clarita, California

	Tonnes / Year	%
2004 World Emissions	2.68E+10	0.00006%
2004 USA Emissions	7.00E+09	0.0002%
2004 CA Emissions	4.80E+08	0.0033%
Total Project Annual Emissions	1.59E+04	

BAU Projected 2020 CO_2e emissions	5.96E+08	tonnes
CA 1990 CO_2e emissions	4.27E+08	tonnes
Difference	1.69E+08	tonnes
% reduction / increase	28%	%
CA 2020 population	4.22E+07	people
1990 emissions / 2020 population	10.1	tonnes / capita

Vista Canyon Population	3,463

	Tonnes CO_2 / year	Tonnes / capita / year
Vista Canyon Mobile Emissions	7,460	2.2
Vista Canyon Residential Emissions	2,728	0.8
Vista Canyon Municipal Emissions	468	0.1
Vista Canyon Mobile + Residential + Municipal	10,656	3.1
Vista Canyon Total Annualized Emissions	15,892	4.6

Table 5-2a
CARB 2020 NAT GHG Emissions from Residential Building Energy Use
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	
Minimally 2005 Title 24 Compliant (CARB 2020 NAT)	**Multi-family**	579	1.7	996		2.4	1,362		2.8	1,595	
	Single family	106	2.6	274	**2,148**	3.4	363	**2,908**	4.0	429	**3,413**
	Town Home	432	2.0	878		2.7	1,184		3.2	1,390	
20% Better Than 2008 Title 24 and Energy Star Appliances	**Multi-family**	579	1.3	733		1.8	1,068		2.2	1,283	
	Single family	106	1.8	194	**1,572**	2.6	273	**2,262**	3.2	334	**2,728**
	Town Home	432	1.5	645		2.1	921		2.6	1,111	
Percentage Improvement over 2005 Title 24 (CARB 2020 NAT)	**Multi-family**	579	26%	26%		22%	22%		20%	20%	
	Single family	106	29%	29%	**27%**	25%	25%	**22%**	22%	22%	**20%**
	Town Home	432	27%	27%		22%	22%		20%	20%	

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Vista Canyon Ranch, LLC.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2 - carbon dioxide
DU - Dwelling Unit
MEL - Miscellaneous electric loads
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 5-2b
CARB 2020 NAT GHG from Residential Building Energy Use: Overlay Option
Vista Canyon
Santa Clarita, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)		CO_2 Emission Factor (tonne CO_2 / DU / year)	Total CO_2 Emissions (tonne CO_2 / year)	
Minimally 2005 Title 24 Compliant (CARB 2020 NAT)	**Multi-family**	812	1.7	1,396		2.4	1,910		2.8	2,236	
	Single family	106	2.6	274	**2,549**	3.4	363	**3,456**	4.0	429	**4,055**
	Town Home	432	2.0	878		2.7	1,184		3.2	1,390	
20% Better Than Title 2008 24 and Energy Star Appliances	**Multi-family**	812	1.3	1,029		1.8	1,498		2.2	1,800	
	Single family	106	1.8	194	**1,868**	2.6	273	**2,692**	3.2	334	**3,245**
	Town Home	432	1.5	645		2.1	921		2.6	1,111	
Percentage Improvement over CARB 2020 NAT	**Multi-family**	812	26%	26%		22%	22%		20%	20%	
	Single family	106	29%	29%	**27%**	25%	25%	**22%**	22%	22%	**20%**
	Town Home	432	27%	27%		22%	22%		20%	20%	

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Vista Canyon Ranch, LLC.

Abbreviations:
CO_2 - carbon dioxide
DU - Dwelling Unit
MEL - Miscellaneous electric loads
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 5-3a
CARB 2020 NAT GHG Emissions from Non-Residential Building Energy Use
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1]	EIA Building Category[2]	% Area[3]	Related Area[4]	Annual Area Emission Factor		Total Annual CO_2e Emissions (CARB 2020 NAT)						Total Annual CO2e Emissions (Project)	Percent CO_2e Reductions over 2005 Title 24 (CARB 2020 NAT)
					2005 Title 24 Compliant (CARB 2020 NAT)	20% Better than 2008 Title 24	2005 Title 24 Compliant (CARB 2020 NAT)		2008 Title 24 Compliant		20% Better than 2008 Title 24		20% Better than 2008 Title 24 and On-Site Emission Savings[7]	
	(SF)			(SF)	(Tonne CO_2e / SF / year)[5]		(Tonne CO_2e / year)[6]							
General Office	646,000	Administrative/professional office	50%	323,000	5.04E-03	3.91E-03	1,628		1,461		1,264			
		Mixed-use office	50%	323,000	5.00E-03	3.89E-03	1,614		1,448		1,257			
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000	1.60E-02	1.36E-02	241		219		204			
Retail - Other than Mall	79,000	Other retail	50%	39,500	6.96E-03	5.47E-03	275		248		216			
		Retail store	50%	39,500	3.18E-03	2.50E-03	126	**6,308**	113	**5,692**	99	**5,003**	**4,652**	**26%**
Food Service	39,000	Restaurant/cafeteria	50%	19,500	2.19E-02	1.82E-02	427		392		355			
		Fast food	50%	19,500	3.90E-02	3.30E-02	760		696		644			
Lodging	140,000	Hotel	100%	140,000	6.41E-03	5.02E-03	897		812		702			
Public Assembly	31,000	Entertainment/culture	100%	31,000	1.10E-02	8.43E-03	340		304		261			

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON mapped each Vista Canyon building type to an EIA.
3. The percentage of each Vista Canyon building type assigned to each of the EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly.
4. The product of the area of the Vista Canyon building type and the percentage of each subcategory.
5. Emissions per square foot per year as calculated in Table 4-19.
6. Emissions for each building type are calculated as emissions per square foot times square footage.
7. Vista Canyon Ranch, LLC plans to install on-site mitigation systems that provide greenhouse gas reductions equivalent to the emission savings from 80,000 square feet of solar panels.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
SF - Square Feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 5-3b
CARB 2020 NAT GHG Emissions from Non-Residential Building Energy Use: Overlay Option
Vista Canyon
Santa Clarita, California

General Building Type[1]	Area[1] (SF)	EIA Building Category[2]	% Area[3]	Related Area[4] (SF)	Total Annual CO_2e Emissions (CARB 2020 NAT) (Tonne CO_2e / year)[5]		Total Annual CO_2e Emissions (Project) (Tonne CO_2e / year)[5]		Percent CO_2e Reductions over CARB 2020 NAT
					2005 Title 24 Compliant (CARB 2020 NAT)		20% Better than 2008 Title 24		20% Better than 2008 Title 24 and On-site Emission Savings[6]
General Office	396,000	Administrative/professional office	50%	198,000	998		775		
		Mixed-use office	50%	198,000	989		771		
Retail - Grocery Store	15,000	Grocery store/food market	100%	15,000	241		204		
Retail - Other than Mall	79,000	Other retail	50%	39,500	275		216		
		Retail store	50%	39,500	126	**5,054**	99	**4,027**	**3,676**
Food Service	39,000	Restaurant/cafeteria	50%	19,500	427		355		
		Fast food	50%	19,500	760		644		
Lodging	140,000	Hotel	100%	140,000	897		702		
Public Assembly	31,000	Entertainment/culture	100%	31,000	340		261		

Notes:
1. Building types and areas provided by Vista Canyon Ranch, LLC.
2. Building types used in EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS) databases. ENVIRON mapped each Vista Canyon Ranch building type to an EIA category.
3. The percentage of each Vista Canyon building type assigned to each of the EIA categories. ENVIRON assumed an equal split when multiple EIA categories were assigned except for public assembly.
4. The product of the area of the Vista Canyon building type and the percentage of each subcategory.
5. Emissions for each building type are calculated as emissions per square foot times square footage.
6. Vista will install on-site features that provide 351 tonnes of GHG emission reductions, which is equivalent to 80,000 square feet of photovoltaic panels.

Abbreviations:
CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CO_2e - Carbon dioxide equivalent
EIA - Energy Information Administration
SF - Square Feet
Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.

Sources:
US Energy Information Administration. 2003 Commercial Buildings Energy Consumption Survey: http://www.eia.doe.gov/emeu/cbecs/contents.html

Table 5-4a
CARB 2020 NAT GHG Emissions from Vehicles for the Year 2020
Vista Canyon
Santa Clarita, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Internal	Home Based Work	281	265	0.31	81	29,583	353	114	10	11	21	23
	Home Based Other	484	456	0.31	140	50,948			18	19	37	39
Total Internal Resident Trips		*765*	*721*			*80,530*			*28*	*30*	*58*	*62*
External	Home Based Work	1,592	1,501	24	36,742	13,410,759	385	114	5,169	62	5,231	5,506
	Home Based Other	4,354	4,105	7	30,150	11,004,711			4,241	171	4,412	4,644
Total External Resident Trips		*5,945*	*5,606*		0	*24,415,469*			*9,410*	*233*	*9,643*	*10,151*
Total Non-Home Based Trips (offsite)		*1,092*	*1,030*	*7*	7,564	*2,761,039*	385	114	*1,064*	*43*	*1,107*	*1,165*
Totals		**7,802**	**7,356**		74,677	**27,257,038**			**10,503**	**306**	**10,809**	**11,378**

Notes:

1. The trip type distribution is based on data provided by Fehr & Peers. The distribution of internal to external trips for each trip type is the following:

Trip Type	Internal	External	Proportion of Total Home Based Trips
Home Based Work	15%	85%	28%
Home Based Other	10%	90%	72%

2. Total weekday daily one-way trips data was provided by Fehr & Peers.

3. Daily trips were adjusted to account for differences between weekend and weekday traffic, based on a report by Sonoma Technology. The weekend traffic (internal) was assumed to be 80% of weekly capacity. The weekend traffic (external) was assumed to be 80% of weekly capacity. There has been no weekend adjustment made for mode shifts.

4. CARB 2020 NAT trip distances were increased by approximately 22% relative to the project scenario, to reflect an overall increase in VMT per dwelling unit from 58 to 71 miles per day. According to Fehr & Peers the adjusted

VMT reflects the specifications in Santa Clarita's One Valley One Vision development plan, which excludes the transit center and non-residential land uses of the current project plan. ENVIRON assumed the same number of trips for the CARB 2020 NAT and project scenarios.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for Los Angeles County. Speeds of 35 miles per hour for internal trips and 60 miles per hour for external trips and non-home based trips were used to determine emission factors. No reduction in the emission factor was taken for any regulatory programs.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

References:

Fehr&Peers. 2009. Draft Transportation Impact Study for Vista Canyon Transit-Oriented Development. May 15.
NCHRP Report 365. 1998. Travel Estimation Techniques for Urban Planning.
Sonoma Technology, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 5-4b
CARB 2020 NAT GHG Emissions from Vehicles for the Year 2020: Overlay Option
Vista Canyon
Santa Clarita, California

Scenario[1]	Number of Dwelling Units	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[3]
Project	1,117	74,677	27,257,038	10,503	306	10,809	11,378
Overlay[2]	1,350	90,254	32,942,705	12,693	370	13,063	**13,751**

Notes:

1. The Project scenario and Overlay scenario differ by the number of dwelling units and square footage of office space.

2. For the overlay option it was assumed that all residential mobile source parameters (vehicle miles traveled per dwelling unit, trip length, trip types) were the same as for the project scenario. The estimates presented in this row were scaled from the project scenario based on the number of dwelling units. Thus, VMT and emissions for the project scenario were multiplied by a factor of (1350/1117) to generate estimates for the overlay scenario.

3. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
URBEMIS - Urban Emissions model
VMT - Vehicle Miles Traveled

References:

Fehr and Peers. 2009. Draft Transportation Impact Study for Vista Canyon Transit-Oriented Development. May 15.
NCHRP Report 365. 1998. Travel Estimation Techniques for Urban Planning.
Sonoma Technology, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 5-5a
CARB 2020 NAT GHG Emissions from Municipal Sources
Vista Canyon
Santa Clarita, California

Source[1]	Energy Requirements	Units	Emission Factor	Units	Source Quantity	Units	Total CO_2e Emissions [Tonne CO_2e per year]
Lighting							
Public Lighting[2]	149	kW-hr/capita/yr	0.043	tonne CO_2e/capita/year	3,463	residents (capita)	147
						Public Lighting Total:	**147**
Municipal Vehicles							
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	3,463	residents (capita)	173
						Municipal Vehicles Total:	**173**
Water and Wastewater [12, 13]							
Groundwater Supply and Conveyance (Potable)[4,5]	2,915	kW-hr/million gallons	0.83	tonne / million gallons	46	million gallons/year	38
State Water Project Supply and Conveyance (Potable)[4,6]	9,931	kW-hr/million gallons	2.84	tonne / million gallons	71	million gallons/year	203
Water Treatment (Potable)[7]	111	kW-hr/million gallons	0.03	tonne / million gallons	117	million gallons/year	4
Water Distribution (Potable)[8]	1,272	kW-hr/million gallons	0.36	tonne / million gallons	117	million gallons/year	43
On-site Wastewater Treatment (Indirect Emissions)[9, 10]	2,011	kW-hr/million gallons	0.58	tonne / million gallons	133	million gallons/year	76
Recycled Water Distribution (Non-Potable)[11]	2,100	kW-hr/million gallons	0.60	tonne / million gallons	1	million gallons/year	1
						Water and Wastewater Total:	**364**
						Municipal Sources Total:	**685**

Notes:

1. Public Lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution. GHG emissions attributed to electricity use are calculated using the Southern California Edison carbon-intensity factor.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from Southern California Edison.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. The Castaic Lake Water Agency (CLWA) - Santa Clarita Water Division (SCWD) provides water to Vista Canyon Ranch. Water supply and conveyance is based on two different sources: State Water Project and local groundwater.

According to the 2008 Water Requirements and Supplies report, 61% of the water supply to Vista Canyon is from the State Water Supply, and the remaining 39% is from local groundwater.

5. Emission factor for groundwater supply and conveyance is based on information provided in the 2005 CEC report and the electricity generation emission factor from Southern California Edison.

6. Emission factor for the State Water Project is based on information provided by Wilkinson 2000 and the electricity generation emission factor from Southern California Edison.

7. Emission factor for water treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

8. Emission factor for water distribution is based on a 2006 Navigant Consulting refinement of a CEC study on the energy necessary to distribute 1 million gallons of treated water and the Southern California-specific electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

9. An emission factor of 1,911 kWh/million gallons for wastewater treatment is based on information provided in the 2006 Navigant Consulting refinement of a CEC study and the electricity generation emission factor from Southern California Edison. An emission factor of 100 kWh/million gallons is also included to account for the energy used in UV disinfection of wastewater, which is specified in the Engineering Report for the Vista Canyon Water Factory.

10. According to Dexter Wilson Engineering Inc., there will be no direct emissions of methane or nitrous oxide from the wastewater treatment plant.

11. Emission factor for recycled water distribution is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. ENVIRON used the average of the range of emission factors presented in the report. ENVIRON assumed that the recycled water demand is 1.1% of the total water demand - see Note 13 for more details.

12. Source quantities for water and wastewater are based on the Engineering Report for the Vista Canyon Water Factory.

13. For this calculation, ENVIRON assumed that the recycled water demand is 1.1% of the total water demand, which is the fraction of recycled water in the 2008 Santa Clarita water supply. No recycled water is sent off-site in the CARB 2020 NAT scenario.

The potable water demand was adjusted to give a total water demand of 363,151 gallons/day, consistent with the design of Vista Canyon.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
kW-hr - kilowatt hour
MW-hr - megawatt hour
USEPA - United States Environmental Protection Agency

Sources:

California Climate Action Registry (CCAR) Database. Southern California Edison Annual Emissions Report. 2008.
California Energy Commission. 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.
California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives. October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf
Wilkinson, Robert. 2000. Methodology for Analysis of the Energy Intensity of California's Water Systems, and An Assessment of Multiple Potential Benefits through Integrated Water-Energy Efficiency Measures.
CLWA Santa Clarita Water Division. 2008. Water Requirements and Supplies. http://www.clwa.org/about/pdfs/2008WaterRequirementsadSupplies.pdf
Dexter Wilson Engineering, Inc. 2009. Engineering Report for the Vista Canyon Water Factory. July.

Table 5-5b
CARB 2020 NAT GHG Emissions from Municipal Sources: Overlay Option
Santa Clarita, California

Source[1]	Energy Requirements	Units	Emission Factor	Units	Source Quantity	Units	Total CO_2e Emissions [Tonne CO_2e per year]
Lighting							
Public Lighting[2]	149	kW-hr/capita/yr	0.043	tonne CO_2e/capita/year	4,185	residents (capita)	178
						Public Lighting Total:	**178**
Municipal Vehicles							
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	4,185	residents (capita)	209
						Municipal Vehicles Total:	**209**
Water and Wastewater [12, 13]							
Groundwater Supply and Conveyance (Potable)[4,5]	2,915	kW-hr/million gallons	0.83	tonne / million gallons	48	million gallons/year	40
State Water Project Supply and Conveyance (Potable)[4,6]	9,931	kW-hr/million gallons	2.84	tonne / million gallons	75	million gallons/year	212
Water Treatment (Potable)[7]	111	kW-hr/million gallons	0.03	tonne / million gallons	122	million gallons/year	4
Water Distribution (Potable)[8]	1,272	kW-hr/million gallons	0.36	tonne / million gallons	122	million gallons/year	45
On-site Wastewater Treatment (Indirect Emissions)[9,10]	2,011	kW-hr/million gallons	0.58	tonne / million gallons	128	million gallons/year	73
Recycled Water Distribution (Non-Potable)[11]	2,100	kW-hr/million gallons	0.60	tonne / million gallons	1	million gallons/year	1
						Water and Wastewater Total:	**375**
						Municipal Sources Total:	**762**

Notes:

1. Public Lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution. GHG emissions attributed to electricity use are calculated using the Southern California Edison carbon-intensity factor.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from Southern California Edison.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. The Castaic Lake Water Agency (CLWA) - Santa Clarita Water Division (SCWD) provides water to Vista Canyon. Water supply and conveyance is based on two different sources: State Water Project and local groundwater. According to the 2008 Water Requirements and Supplies report, 61% of the water supply to Vista Canyon Ranch is from the State Water Supply, and the remaining 39% is from local groundwater.

5. Emission factor for groundwater supply and conveyance is based on information provided in the 2005 CEC report and the electricity generation emission factor from Southern California Edison.

6. Emission factor for the State Water Project is based on information provided by Wilkinson 2000 and the electricity generation emission factor from Southern California Edison.

7. Emission factor for water treatment is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

8. Emission factor for water distribution is based on a 2006 Navigant Consulting refinement of a CEC study on the energy necessary to distribute 1 million gallons of treated water and the Southern California-specific electricity generation emission factor from Southern California Edison. This factor is applied to potable water demand.

9. An emission factor of 1,911 kWh/million gallons for wastewater treatment is based on information provided in the 2006 Navigant Consulting refinement of a CEC study and the electricity generation emission factor from Southern California Edison. An emission factor of 100 kWh/million gallons is also included to account for the energy used in UV disinfection of wastewater, which is specified in the Engineering Report for the Vista Canyon Water Factory.

10. According to Dexter Wilson Engineering Inc., there will be no direct emissions of methane or nitrous oxide from the wastewater treatment plant.

11. Emission factor for recycled water distribution is based on information provided in the 2006 Navigant Consulting refinement of the 2005 CEC study and the electricity generation emission factor from Southern California Edison. ENVIRON used the average of the range of emission factors presented in the report. ENVIRON assumed that the recycled water demand is 1.1% of the total water demand - see Note 13 for more details.

12. Source quantities for water and wastewater are based on the Engineering Report for the Vista Canyon Water Factory.

13. For this calculation, ENVIRON assumed that the recycled water demand is 1.1% of the total water demand, which is the fraction of recycled water in the 2008 Santa Clarita water supply. No recycled water is sent off-site in the CARB 2020 NAT scenario.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken
CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
kW-hr - kilowatt hour
MW-hr - megawatt hour
USEPA - United States Environmental Protection Agency

Sources:

California Climate Action Registry (CCAR) Database. Southern California Edison Annual Emissions Report. 2008.
California Energy Commission. 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.
California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives. October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf

Table 5-6a
GHG Emissions Comparison of CARB 2020 NAT to Vista Canyon
Vista Canyon
Santa Clarita, California

Source	CARB 2020 NAT	Vista Canyon Ranch[7]	Percentage Improvement over CARB 2020 NAT [1]
	GHG Emissions (tonnes CO_2e / year)		(%)
Vegetation	-105	-105	0%
Construction	21,397	21,397	0%
Total (one-time emissions)	**21,292**	**21,292**	**0%**
Residential[2]	3,413	2,728	20%
Non-Residential[3]	6,308	4,652	26%
Total Transportation[4]	11,378	7,509	34%
Mobile	*11,378*	*7,460*	--
Transit Center	*0*	*49*	--
Municipal[5]	685	468	32%
Area	1	1	--
Swimming Pools	2	2	--
Total (annual emissions)	**21,787**	**15,360**	**29.5%**
Annualized Total[6]	**22,319**	**15,892**	**28.8%**

Notes:

1. The percentage improvement over CARB 2020 NAT is an estimate. There are some source categories where appropriate comparisons are available. It is estimated that this value is conservative.

2. CARB 2020 NAT residential emissions reflect minimally 2005 Title-24 compliant homes without Energy Star appliances.

3. Project scenario assumes 20% improvement over 2008 Title 24 and 351 tonnes GHG reduction from on-site rooftop energy systems. CARB 2020 NAT non-residential emissions reflect minimally 2005 Title-24 compliant buildings and no GHG emission reductions from on-site energy systems.

4. CARB 2020 NAT scenario for transportation assumes no transit center and a VMT of 71 miles per dwelling unit per day, based on Fehr and Peers' analysis of a scenario where no non-residential land uses and no public transit center are present.

5. Municipal emissions included here are related to water treatment, waste water treatment, street lighting, and municipal vehicles. The CARB 2020 NAT scenario assumes that no recycled water will be used onsite or sent for use offsite.

6. One-time emissions are annualized over 40 years and then added to the total annual emissions.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken

Table 5-6b
GHG Emissions Comparison of CARB 2020 NAT to Vista Canyon: Overlay Option
Vista Canyon
Santa Clarita, California

Source	CARB 2020 NAT	Vista Canyon	Percentage Improvement over CARB 2020 NAT [1]
	GHG Emissions (tonnes CO_2e / year)		(%)
Vegetation	-105	-105	0%
Construction	20,069	20,069	0%
Total (one-time emissions)	**19,963**	**19,963**	**0%**
Residential[2]	4,055	3,245	20%
Non-Residential[3]	5,054	3,676	27%
Total Transportation[4]	13,751	9,065	34%
Mobile	*13,751*	*9,016*	--
Transit Center	*0*	*49*	--
Municipal[5]	762	550	28%
Area	1	1	--
Swimming Pools	2	2	--
Total (annual emissions)	**23,625**	**16,539**	**30.0%**
Annualized Total[6]	**24,124**	**17,038**	**29.4%**

Notes:

1. The percentage improvement over CARB 2020 NAT is an estimate. There are some source categories where appropriate comparisons are available. It is estimated that this value is conservative.

2. CARB 2020 NAT residential emissions reflect minimally 2005 Title-24 compliant homes without Energy Star appliances.

3. CARB 2020 NAT non-residential emissions reflect minimally 2005 Title-24 compliant buildings and no GHG emission reductions from on-site energy systems.

4. CARB 2020 NAT scenario for transportation assumes no transit center and a VMT of 71 miles per dwelling unit per day, based on Fehr and Peers' analysis of a scenario where no non-residential land uses and no public transit center are present.

5. Municipal emissions included here are related to water treatment, waste water treatment, street lighting, and municipal vehicles. The CARB 2020 NAT scenario assumes that no recycled water will be used onsite or sent for use offsite.

6. One-time emissions are annualized over 40 years and then added to the total annual emissions.

Abbreviations:

CARB 2020 NAT - California Air Resources Board 2020 No Action Taken