4.8 Greenhouse Gas Emissions

This section discusses greenhouse gas (GHG) emissions anticipated to result from campus development and growth under the proposed 2021 LRDP and discusses potential conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions. The analysis in this section is based upon GHG emissions methodology and modeling outputs that are included in Appendix G, GHG Emissions Supporting Information, of this EIR as well as guidance and direction provided by UCR staff.

4.8.1 Environmental Setting

Greenhouse Effect, Global Warming, and Climate Change

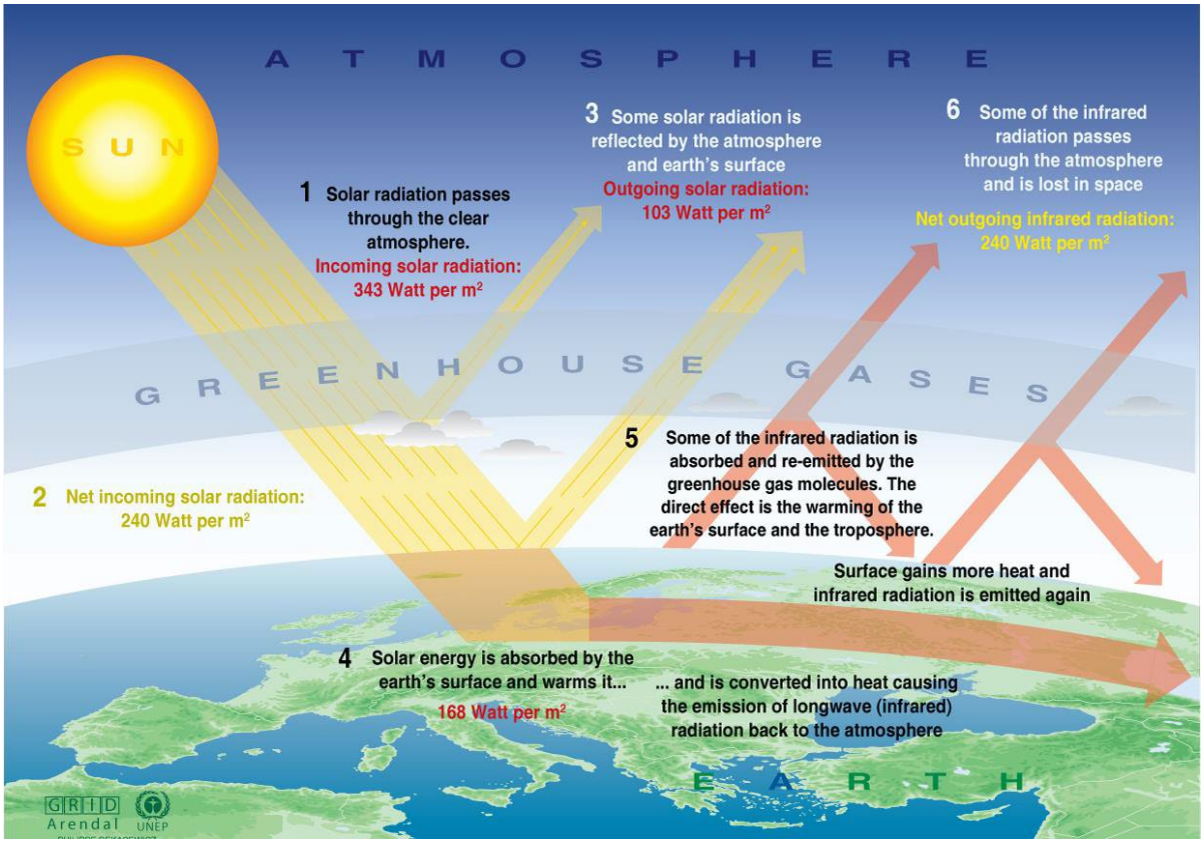
Most of the energy that affects the Earth's climate comes from the sun. Some solar radiation is absorbed by the Earth's surface, and a smaller portion of this radiation is reflected by the atmosphere back toward space. As the Earth absorbs high frequency solar radiation, its surface gains heat and then re-radiates lower frequency infrared radiation back into the atmosphere.[1]

Most solar radiation passes through gases in the atmosphere classified as GHGs; however, infrared radiation is selectively absorbed by GHGs. GHGs in the atmosphere play a critical role in maintaining the balance between the Earth's absorbed and radiated energy, the Earth's radiation budget,[2] by trapping some of the infrared radiation emitted from the Earth's surface that otherwise would have escaped to space (see Figure 4.8-1). Radiative forcing is the difference between the incoming energy and outgoing energy.[3] Specifically, GHGs affect the radiative forcing of the atmosphere,[4] which in turn affects the Earth's average surface temperature. This phenomenon, *the greenhouse effect*, keeps the Earth's atmosphere near the surface warmer than it would be otherwise and allows successful habitation by humans and other forms of life.

Combustion of fossil fuels and deforestation release carbon into the atmosphere that historically has been stored underground in sediments or in surface vegetation, thereby exchanging carbon from the geosphere and biosphere to the atmosphere in the carbon cycle. With the accelerated increase in fossil fuel combustion and deforestation since the Industrial Revolution of the 19th century, concentrations of GHGs in the atmosphere have increased exponentially. Such emissions of GHGs in excess of natural ambient concentrations contribute to the enhancement of the natural greenhouse effect. This enhanced greenhouse effect has contributed to *global warming*, an increased rate of warming of the Earth's average surface temperature.[5] Specifically, increases in GHGs lead to increased absorption of infrared radiation by the Earth's atmosphere and warm the lower atmosphere further, thereby increasing temperatures and evaporation rates near the surface.

[1] Frequencies at which bodies emit radiation are proportional to temperature. The Earth has a much lower temperature than the sun and emits radiation at a lower frequency (longer wavelength) than the high frequency (short-wavelength) solar radiation emitted by the sun.
[2] This includes all gains of incoming energy and all losses of outgoing energy; the planet is always striving to be in equilibrium.
[3] Positive forcing tends to warm the surface while negative forcing tends to cool it.
[4] This is the change in net irradiance at the tropopause after allowing stratospheric temperatures to readjust to radiative equilibrium, but with surface and tropospheric temperatures and state held fixed at the unperturbed values.
[5] This condition results when the Earth has to work harder to maintain its radiation budget, because when more GHGs are present in the atmosphere, the Earth must force emissions of additional infrared radiation out into the atmosphere.

Figure 4.8-1 The Greenhouse Gas Effect



Source: United Nations Environmental Program/GRID-Arendal 2005

Variations in natural phenomena such as volcanoes and solar activity produced most of the global temperature increase that occurred during preindustrial times. More recently, however, increasing atmospheric GHG concentrations resulting from human activity have been responsible for most of the observed global temperature increase.[6]

Warming affects global atmospheric circulation and temperatures; oceanic circulation and temperatures; wind and weather patterns; average sea level; ocean acidification; chemical reaction rates; precipitation rates, timing, and form; snowmelt timing and runoff flow; water supply; wildfire risks; and other phenomena, in ways collectively referred to as *climate change*. Climate change is the alteration in the average weather of the Earth that is measured by modifications in wind patterns, storms, precipitation, and temperature. These changes are assessed using historical records of temperature changes occurring in the past, such as during previous ice ages. Many of the concerns regarding climate change use this data to extrapolate a level of statistical significance specifically focusing on temperature records from the last 150 years (the Industrial Age) that differ from previous climate changes in rate and magnitude.

[6] These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion.

Temperature Predictions

The United Nations Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC constructed several emission trajectories of GHGs needed to stabilize global temperatures and climate change impacts. In its Fourth Assessment Report, the IPCC predicted that the global mean temperature change from 1990 to 2100, given six scenarios, could range from 1.1 degrees Celsius (°C) to 6.4°C. Regardless of analytical methodology, global average temperatures and sea levels are expected to rise under all scenarios. The report also concluded that "[w]arming of the climate system is unequivocal," and that "[m]ost of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations." Warming of the climate system is now considered to be unequivocal, with the global surface temperature increasing about 1.33 degrees Fahrenheit (°F) over the last 100 years. The IPCC predicts increases in global average temperature of between 2°F and 11°F over the next 100 years (IPCC 2007a).

Greenhouse Gases and Global Emission Sources

Gases that trap heat in the atmosphere are referred to as GHGs. Prominent GHGs that naturally occur in the Earth's atmosphere are water vapor, carbon dioxide (CO_2), methane (CH_4), oxides of nitrogen (NO_X), and ozone. Anthropogenic (human-caused) GHG emissions include releases of these GHGs plus release of human-made gases with high global warming potential (GWP) (ozone-depleting substances such as chlorofluorocarbons [CFCs])[7] and aerosols, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The GHGs listed by the IPCC (CO_2, CH_4, nitrous oxide (N_2O), HFCs, PFCs, and SF_6) are discussed below, in order of abundance in the atmosphere. Water vapor, despite being the most abundant GHG, is not discussed below, because natural concentrations and fluctuations far outweigh anthropogenic influences, making it impossible to predict. Ozone is not included, because it does not directly affect radiative forcing. Ozone-depleting substances (CFCs, halons, carbon tetrachloride, methyl chloroform, and hydrochlorofluorocarbons) are not included, because they have been replaced by HFCs and PFCs.

The global warming potential is the potential of a gas or aerosol to trap heat in the atmosphere and is essentially a measurement of the radiative forcing of a GHG compared with the reference gas, CO_2. Individual GHG compounds have varying potential for contributing to global warming. For example, CH_4 is 25 times as potent as CO_2, while SF_6 is 22,200 times more potent than CO_2 on a molecule-per-molecule basis. To simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas. The most commonly accepted method for comparing GHG emissions is the GWP methodology defined in the IPCC reference documents (IPCC 2014a). The IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of carbon dioxide equivalents (CO_2e), which compares the gas in question to that of the same mass of CO_2 (by definition, CO_2 has a GWP of 1). The global warming potential of a GHG is a measure of how much a given mass of a GHG is estimated to contribute to global warming. Thus, to describe how much global warming a given type and amount of GHG may cause, the CO_2e is used. A CO_2e is the mass emissions of an individual GHG multiplied by its global warming potential. As such, a high GWP represents high absorption of infrared radiation and a long atmospheric lifetime compared to CO_2. One must also select a time horizon to convert GHG emissions to equivalent CO_2

[7] CFCs destroy stratospheric ozone. The Montreal Protocol on Substances that Deplete the Ozone Layer prohibited CFCs production in 1987.

emissions to account for chemical reactivity and lifetime differences among various GHG species. The standard time horizon for climate change analysis is 100 years. Generally, GHG emissions are quantified in terms of metric tons (MT) CO_2e emitted per year.

The atmospheric residence time of a gas is equal to the total atmospheric abundance of the gas divided by its rate of removal (Seinfeld 2006). The atmospheric residence time of a gas is, in effect, a half-life measurement of the length of time a gas is expected to persist in the atmosphere when accounting for removal mechanisms such as chemical transformation and deposition. Table 4.8-1 lists the GWP of each GHG and its lifetime. Units commonly used to describe the concentration of GHGs in the atmosphere are parts per million (ppm), parts per billion (ppb), and parts per trillion (ppt), referring to the number of molecules of the GHG in a sampling of 1 million, 1 billion, or 1 trillion molecules of air. Collectively, HFCs, PFCs, and SF_6 are referred to as high-GWP gases. CO_2 is by far the largest component of worldwide CO_2e emissions, followed by CH_4, N_2O, and high-GWP gases, in order of decreasing contribution to CO_2e.

The primary human processes that release GHGs include the burning of fossil fuels for transportation, heating, and electricity generation; agricultural practices that release CH_4, such as livestock grazing and crop residue decomposition; and industrial processes that release smaller amounts of high-GWP gases. Deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove CO_2 from the air and altering the Earth's albedo or surface reflectance, thus allowing more solar radiation to be absorbed. Specifically, CO_2 emissions associated with fossil fuel combustion are the primary contributors to human-induced climate change. CO_2, CH_4, and N_2O emissions associated with human activities are the next largest contributors to climate change. GHGs of California concern are defined by California Assembly Bill (AB) 32 (see the Regulatory Environment subsection below for a description) and include CO_2, CH_4, NO_X, HFCs, PFCs, and SF_6. A seventh GHG, nitrogen trifluoride (NF_3), was also added under the California Health and Safety Code Section 38505(g)(7) as a GHG of concern. These GHGs are described in terms of their physical description and properties, global warming potential, atmospheric residence lifetime, sources, and atmospheric concentration in 2005 in Table 4.8-1.

Table 4.8-1 Description of Greenhouse Gases of California Concern

Greenhouse Gas	Physical Description and Properties	Global Warming Potential (100 years)	Atmospheric Residence Lifetime (years)	Sources
Carbon dioxide (CO_2)	Odorless, colorless, natural gas.	1	50–200	Burning coal, oil, natural gas, and wood; decomposition of dead organic matter; respiration of bacteria, plants, animals, and fungus; oceanic evaporation; volcanic outgassing; cement production; land use changes.
Methane (CH_4)	Flammable gas and is the main component of natural gas.	25	12	Geological deposits (natural gas fields) extraction; landfills; fermentation of manure; and decay of organic matter.
Nitrous oxide (N_2O)	N_2O (laughing gas) is a colorless GHG.	298	114	Microbial processes in soil and water; fuel combustion; industrial processes.

Greenhouse Gas	Physical Description and Properties	Global Warming Potential (100 years)	Atmospheric Residence Lifetime (years)	Sources
Chloro-fluoro-carbons (CFCs)	Nontoxic, nonflammable, insoluble, and chemically unreactive in the troposphere (level of air at the Earth's surface); formed synthetically by replacing all hydrogen atoms in CH_4 or ethane with chlorine and/or fluorine atoms.	3,800–8,100	45–640	Refrigerants aerosol propellants; cleaning solvents.
Hydro-fluoro-carbons (HFCs)	Synthetic human-made chemicals used as a substitute for CFCs and contain carbon, chlorine, and at least one hydrogen atom.	140-11,700	1–50,000	Automobile air conditioners; refrigerants.
Per-fluoro-carbons (PFCs)	Stable molecular structures and only break down by ultraviolet rays about 60 kilometers above Earth's surface.	6,500-9,200	10,000–50,000	Primary aluminum production; semiconductor manufacturing.
Sulfur hexafluoride (SF_6)	Human-made, inorganic, odorless, colorless, and nontoxic, nonflammable gas.	22,800	3,200	Electrical power transmission equipment insulation; magnesium industry, semiconductor manufacturing; a tracer gas.
Nitrogen trifluoride (NF_3)	Inorganic, is used as a replacement for PFCs, and is a powerful oxidizing agent.	17,200	740	Electronics manufacture for semiconductors and liquid crystal displays.

Sources:
IPCC 2007a
IPCC 2007b

Introduction to Global Climate Change

Global climate change is defined as the change in average meteorological conditions on Earth with respect to temperature, precipitation, and storms. Global temperatures are regulated by naturally occurring atmospheric gases such as water vapor, CO_2, N_2O, CH_4, HFCs, PFCs and SF_6. These gases are important because of their residence time (duration they stay) in the atmosphere, which ranges from 10 years to more than 100 years. These gases allow solar radiation into the Earth's atmosphere, but prevent radioactive heat from escaping thereby warming the Earth's atmosphere. Global climate change can occur naturally as it has in the past with the previous ice ages. According to the

California Air Resources Board (CARB), the climate change since the industrial revolution differs from previous climate changes in both rate and magnitude.

Gases that trap heat in the atmosphere are often referred to as GHGs. GHGs are released into the atmosphere by both natural and anthropogenic (human) activity. Without the natural greenhouse effect, the Earth's average temperature would be approximately 59°F cooler than it is currently. The cumulative accumulation of these gases in the Earth's atmosphere is considered to be the cause for the observed increase in the Earth's temperature (NASA 2010).

Although California's rate of GHG emissions has been reduced in comparison to historical levels, the State is still a substantial contributor to the U.S. emissions production total. In 2004, California is estimated to have produced 492 million metric tons (MMT) of CO_2e GHG emissions. Despite a population increase of 16 percent between 1990 and 2004, California has significantly reduced its GHG emissions rate because of the implementation of a range of energy efficiency programs as well as adoption of strict emission controls. In 2018, GHG emissions from statewide activities were 425 $MMTCO_2e$, 6 $MMTCO_2e$ below the 2020 GHG goal of 431 $MMTCO_2e$ (CARB 2020).

Global Climate Change Issue

Climate change is a global problem, because GHGs are global pollutants, unlike criteria air pollutants and hazardous air pollutants (i.e., toxic air contaminants) that are pollutants of regional and local concern. Pollutants with localized air quality effects have relatively short atmospheric lifetimes, approximately 1 day; by contrast, GHGs have long atmospheric lifetimes, several years to several thousand years. GHGs persist in the atmosphere for enough time to be dispersed around the globe.

Although the exact lifetime of particular GHG molecules depends on multiple variables and cannot be pinpointed, more CO_2 is currently emitted into the atmosphere than is sequestered. CO_2 sinks, or reservoirs, include vegetation and the ocean, which absorb CO_2 through photosynthesis and dissolution, respectively. These are two of the most common processes of CO_2 sequestration. Of the total annual human-caused CO_2 emissions, approximately 54 percent is sequestered through ocean uptake, Northern Hemisphere forest regrowth, and other terrestrial sinks within a year, whereas the remaining 46 percent of human-caused CO_2 emissions is stored in the atmosphere (Seinfeld 2006).

Similarly, effects of GHGs are borne globally, as opposed to the localized air quality effects of criteria air pollutants and hazardous air pollutants. The quantity of GHGs that it takes to ultimately result in climate change is not precisely known and cannot be quantified, and no single plan or project would be expected to measurably contribute to a noticeable incremental change in the global average temperature, or to global or local climates or microclimate. However, emissions of GHGs have the potential to adversely affect the environment, because such emissions contribute, on a cumulative basis, to global climate change.

Existing GHG Emissions

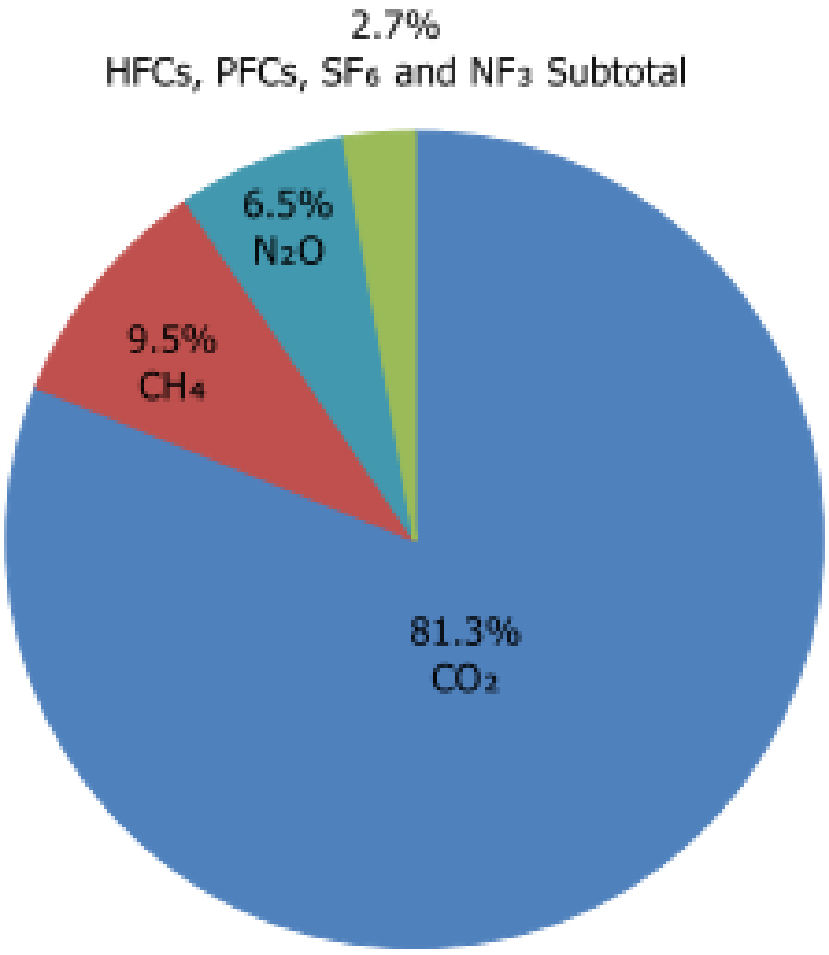
Global GHG Emissions

Worldwide anthropogenic emissions of GHG were approximately 46,000 MMT, or gigatonne of CO_2e in 2010. CO_2 emissions from fossil fuel combustion and industrial processes contributed about 65 percent of total emissions in 2010. Of anthropogenic GHGs, CO_2 was the most abundant accounting for 76 percent of total 2010 emissions. CH_4 emissions accounted for 16 percent of the 2010 total, while N_2O and fluorinated gases account for six and two percent, respectively (IPCC 2014b).

United States GHG Inventory

Total U.S. GHG emissions were 6,676.6 $MMTCO_2e$ in 2018. Total U.S. emissions increased by 3.7 percent from 1990 to 2018. Overall, net emission increase by 3.1 percent from 2017 to 2018 and decreased by 10.2 percent from 2005 to 2018. The decrease from 2005 to 2018 reflects long-term trends, including energy market trends, technological changes including energy efficiency, and energy fuel choices. Between 2017 and 2018, the increase in emissions was driven by an increase in CO_2 emissions from fossil fuel combustion, which was a result of increased energy use from greater heating and cooling needs due to a colder winter and hotter summer in 2018 compared to 2017. In 2018, the largest source of CO_2 and of overall emissions, was fossil fuel combustion, representing approximately 81.3 percent of U.S. GHG emissions (see Figure 4.8-2). CH_4 accounted for nearly 10 percent, N_2O accounted for approximately 6.5 percent, and the remaining 2.7 percent of U.S. GHG emissions were HFCs, PFCs, SF_6, and NF_3 (US EPA 2020).

Figure 4.8-2 2018 U.S. GHG Emissions by Gas

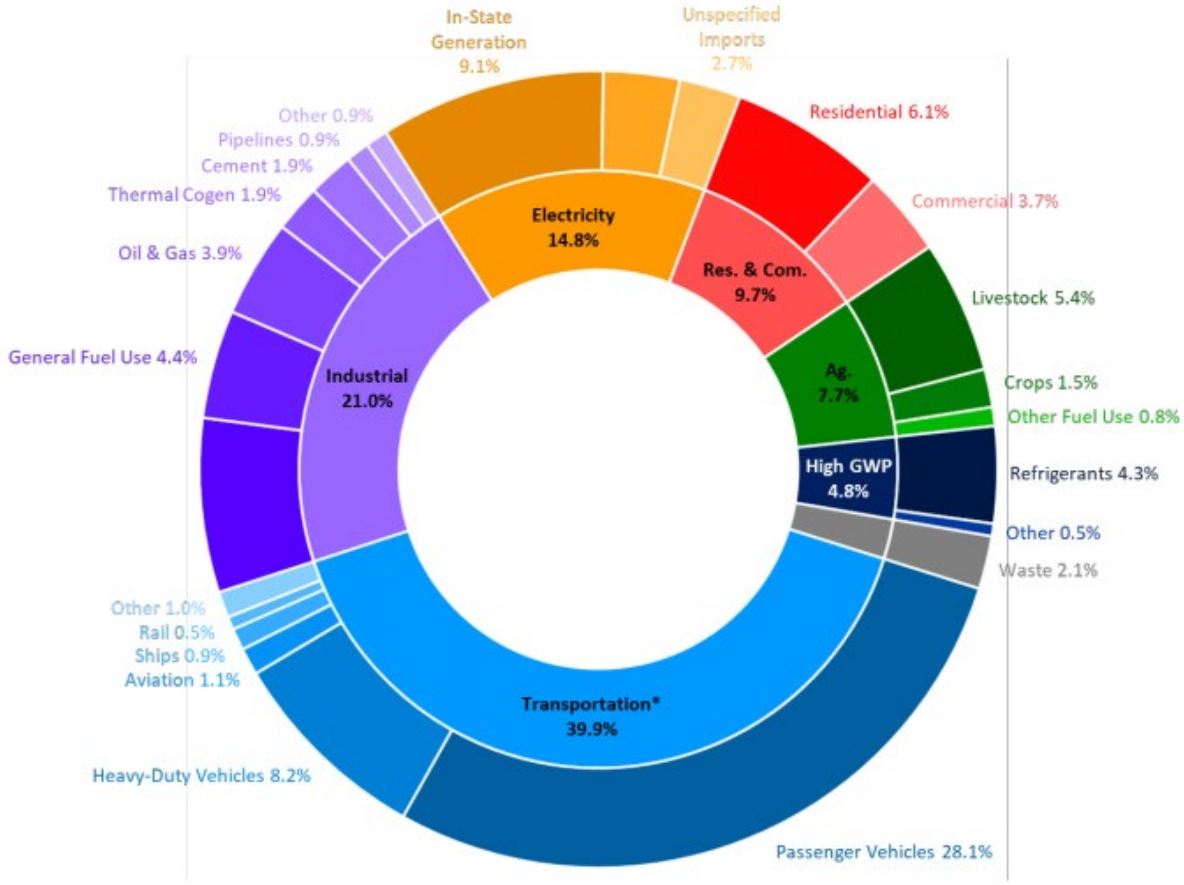


Source: US EPA 2020. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018.

California GHG Inventory

According to the California Air Resources Board (CARB), total California GHG emissions were 425 $MMTCO_2e$ in 2018 (CARB 2020). The major source of GHGs in California is associated with transportation, contributing nearly 40 percent of Statewide GHG emissions in 2018. The industrial sector is the second largest source, contributing 21 percent of Statewide GHG emissions, and the electricity sector accounted for approximately 15 percent (see Figure 4.8-3).

Figure 4.8-3 2018 California GHG Emissions by Scoping Plan Sectors and Sub-Sectors



Note: This figure breaks out 2018 California emissions by sector into an additional level of sub-sector categories. The inner ring shows the broad CARB Climate Change Scoping Plan sectors. The outer ring breaks out the sectors into sub-sectors or emission categories. The transportation sector represents tailpipe emissions from on-road vehicles and direct emissions from other off-road mobile sources; it does not include emissions from petroleum refineries and oil extraction and production, which are included in the industrial sector.

Source: CARB 2020

UCR Main Campus GHG Inventory

UCR prepared an inventory for main campus 2018 GHG emissions.[8] The inventory includes emissions from all main campus facilities and sources. UCR categorizes GHG emissions into three "scopes" based on the nature and source of the emissions and consistent with CARB Climate Change Scoping Plan approach. The following scope emissions are included in the UCR 2018 inventory:

- Scope 1 Emissions: Direct emissions, including stationary combustion such as boilers (e.g. UCR Central Plant), HFC refrigerant use, as well as non-stationary combustion of fuels in University-owned vehicles.
- Scope 2 Emissions: Indirect stationary sources, including emissions from purchased electricity and purchased steam for leased facilities.

[8] The boundaries for the UCR 2018 GHG inventory are limited to the geographic and operational boundary of the proposed 2021 LRDP. Similar to the 2005 LRDP, the proposed 2021 LRDP encompasses the approximate 1,108 contiguous acres constituting the UCR main campus, which is bisected by the I-215/SR 60 freeway into two distinct areas commonly referred to as East Campus and West Campus.

- Scope 3 Emissions: Other indirect emissions from business air travel and from commuting by students, faculty, and staff. Scope 3 is defined as emissions that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution.

Overall UCR GHG emissions were 97,232 $MTCO_2e$ in 2018. The largest component were Scope 2 emissions, which account for 45,834 $MTCO_2e$ (47 percent) of emissions. Scope 3 emissions were the second largest, accounting for 31,263 $MTCO_2e$ (32 percent) of emissions. Scope 1 emissions were the smallest component, accounting for 20,136 $MTCO_2e$ (21 percent) of emissions. Emissions are summarized in Table 4.8-2 and Figure 4.8-4. See calculation details in Appendix G.

Table 4.8-2 UCR 2018 GHG Emissions Inventory

Scope	$MTCO_2e$[1]	Percent of Total Emissions[2]	Percent within Scope[2]
Scope 1	**20,136**	**20**	**100**
Stationary Fuel Combustion (Natural Gas)	18,410	19	91.4
Stationary Fuel Combustion (Diesel)	82	0.1	0.4
Mobile Fuel Combustion (Fleet)	339	0.3	1.7
Process and Fugitive Emissions (Refrigerants)	1,305	1	6.5
Scope 2	**45,834**	**47**	**100**
Electricity Consumption	45,834	47	100.0
Scope 3	**31,263**	**32**	**100**
Business Travel (Faculty/Staff Air Travel)	1,562	2	5.0
On-site Transportation (all non-transit vehicle travel, including employee commute)	26,342	27	84.3
On-site Transportation (vendors)	2,372	2	7.6
Transit Vehicle Transportation (Staff/Student Transit Travel)	743	1	2.4
Waste Generation	244	0.3	0.8
Total Emissions	**97,232**	**–**	**–**

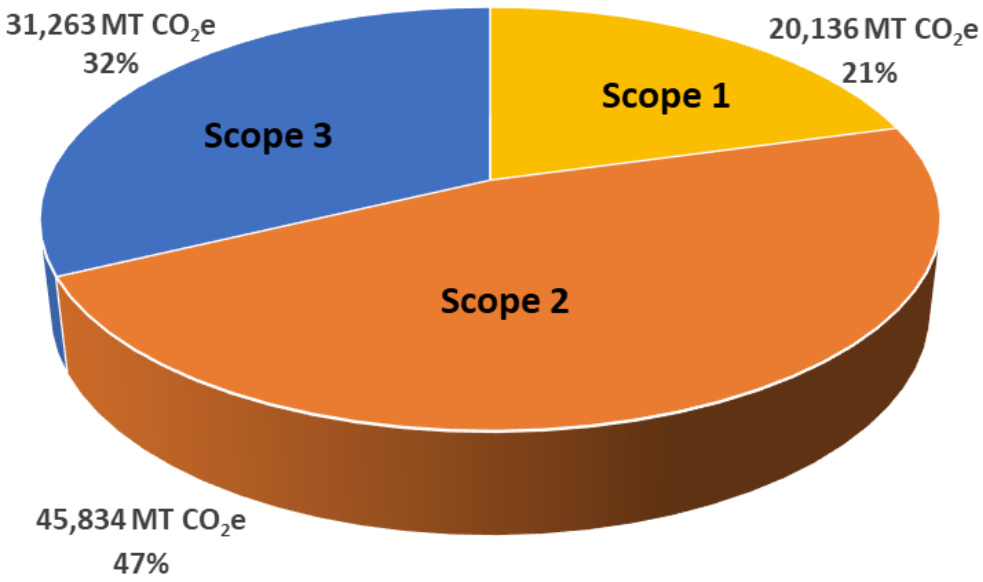
[1] Values are rounded to the nearest whole integer and may not add up to noted total.

[2] Totals are rounded to the nearest whole integer and may not add up to the noted total.

See Appendix G for detailed emission calculations. Activity data and total emissions presented herein is rounded.

Source: UCR Final GHG Inventory, Forecast, and Targets Methodology and Calculations Report (see in Appendix G).

Figure 4.8-4 2018 UCR Emissions by Scope



Source: Appendix G

Electricity Generation - Riverside Public Utility

RPU electricity generation consists of renewable and nonrenewable sources. The renewable sources include geothermal, hydroelectric, solar, wind, and other renewables. RPU internal electricity generation includes coal, large hydroelectric, natural gas, nuclear, and other generic power. Table 4.6-2 in the Section 4.6, *Energy* provides additional details on the RPU electricity generation composition.

According to the 2018 Power Content Label, which discloses power sources from retail electricity suppliers, RPU receives its energy from renewables, hydroelectric, natural gas, nuclear, and unspecific sources. Both RPU's General Power Mix and 100 Percent Renewable Energy Mix have a higher share of renewable energy compared to Statewide. RPU has also reported that it was likely to achieve 44 percent renewable power by 2020. RPU does not offer customers, including UCR, the option to purchase 100 percent renewable-sourced electricity. In addition, there is no separate community choice aggregation available to UCR.

Electricity Generation – UCR

In addition to obtaining electricity from RPU, UCR campus solar power is generated from SunPower photovoltaic (PV) systems. UCR purchases such solar-powered electricity through a power purchase agreement for on-site generation that on average annually produces approximately 11.6 megawatt-hours (MWh) of electricity, or almost 10 percent of the campus's total annual energy needs. Specifically, in 2018, electricity was generated by the following solar facilities on the UCR campus:

- 5,734 annual MWh system via solar panel canopies at UCR Parking Lot 30;
- 1,099 MWh system via solar panel canopies at UCR Parking Lot 32; and

- 5,040 MWh Solar Farm Tracking System scattered throughout the campus, including
  - a solar farm adjacent to agricultural research land and
  - a smaller system above the parking lot of the College of Engineering's Center for Environmental Research and Technology (CE-CERT).

CE-CERT's solar PV array feeds into a 500 kWh battery. The campus also produces solar hot water on the rooftops of the Glen Mor student housing facility.

UCR Electricity Generation, Distribution, and Energy Storage

Electricity used on the UCR campus to provide power for space cooling, heating and ventilation, lighting, research activities, office equipment, and refrigeration is distributed via an extensive network of power distribution infrastructure.

The UCR Sustainable Integrated Grid Initiative (SIGI) was designed as a smart, flexible, micro-grid capable of responding to the critical needs of the electrical grid. There is 0.5 MW of PV power capacity distributed between the three buildings at CE-CERT. The administration building has an energy scheduling system installed that controls large loads and 0.1 MW of the PV capacity. The Multidisciplinary Research Building has a 500 kWh stationary electrical energy storage system that will store or discharge energy in response to a remote command or to a scheduling algorithm and 100 kW of the PV capacity. The remaining 260 kW PV capacity is allocated to the Atmospheric Processes Laboratory. Additionally, 500 kW of battery energy storage is installed in a trailer for mobile deployment (UCR 2021).

Heat waves challenge local utilities to satisfy record-breaking peak energy demands. During a previous heat wave in 2014, RPU requested that their largest customers reduce electricity use in the afternoon. UCR responded to this request by utilizing its SIGI battery system, PV generation, and smart demand management controllers. The combined effect not only curtailed 265 kW of power consumption, but also provided 225 kW back to the grid, resulting in a 590 kW energy swing for the critical period during the afternoon hours. In addition to the demonstration of these functionalities, UCR CE-CERT's SIGI test-bed has the ability to supply reactive power and voltage support, efficiency evaluation of system components, and islanding operations. The other capacity of UCR SIGI is fast electric vehicle charging, along with vehicle to grid energy transfer capability.

UCR Heating/Central Plant

Under existing conditions, UCR privately distributes medium pressure gas throughout East and West Campus. Distribution lines exist under Iowa Avenue and Martin Luther King Boulevard, and under a portion of West Campus. East Campus is served by a distribution line under Blaine Street (SCG 2016). UCR purchases natural gas, 95 percent of which is combusted in four steam boilers at the UCR Central Plant to generate steam for distribution. The Central Plant distributes steam to most buildings in the Academic Center primarily for heating. Some natural gas is also used in the residential dining hall kitchens; on-campus restaurant kitchens; and science, research and teaching laboratories (UCR 2005). One high-pressure natural gas distribution line runs north-south under West Campus between Martin Luther King Boulevard and Le Conte Drive (SCG 2016).

Climate Change Trends and Effects

Globally, climate change has the potential to affect numerous environmental resources through potential impacts related to future air temperatures and precipitation patterns. Scientific modeling

predicts that continued GHG emissions at or above current rates would induce more extreme climate changes during the 21st century than was observed during the 20th century. Long-term trends found that each of the past four decades was warmer than all the previous decades in the instrumental record. The observed global mean surface temperature for the decade from 2006 to 2015 was 0.87°C higher than the global mean surface temperature over the period from 1850 to 1900. Several independently analyzed data records of global and regional Land-Surface Air Temperature obtained from station observations agree that Land-Surface Air Temperature and sea surface temperatures have increased. Due to past and current activities, anthropogenic GHG emissions are increasing global mean surface temperature at a rate of 0.2°C per decade. In addition, there are identifiable signs that global warming is currently taking place, including substantial ice loss in the Arctic over the past two decades (IPCC 2014b; IPCC 2018).

California

According to *California's Fourth Climate Change Assessment*, Statewide temperatures from 1986 to 2016 were approximately 1°F to 2°F higher than those recorded from 1901 to 1960. Potential impacts of climate change in California may include loss in water supply from snowpack, sea level rise, more extreme heat days per year, more large forest fires, and more drought years. While there is growing scientific consensus about the possible effects of climate change at a global and Statewide level, current scientific modeling tools are unable to predict what local impacts may occur with a similar degree of accuracy (California 2018a).

In California, climate change may result in consequences such as the following:

- **A reduction in the quality and supply of water from the Sierra snowpack.** If heat-trapping emissions continue unabated, more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring snowpack by as much as 70 to 90 percent. This can lead to challenges in securing adequate water supplies. It can also lead to a potential reduction in hydropower.
- **Increased risk of large wildfires.** If rain increases as temperatures rise, wildfires in the forests, grasslands and chaparral ecosystems of Southern California are estimated to increase by approximately 30 percent toward the end of the 21st century because more winter rain will stimulate the growth of more plant "fuel" available to burn in the fall. In contrast, a hotter, drier climate could promote up to 90 percent more northern California fires by the end of the century by drying out and increasing the flammability of forest vegetation.
- **Reductions in the quality and quantity of certain agricultural products.** The crops and products likely to be adversely affected include wine grapes, fruit, nuts, and milk.
- **Exacerbation of air quality problems.** If temperatures rise to the medium warming range, there could be 75 to 85 percent more days with weather conducive to ozone formation in Los Angeles and the San Joaquin Valley, relative to today's conditions. This is more than twice the increase expected if rising temperatures remain in the lower warming range. This increase in air quality problems could result in an increase in asthma and other health-related problems.
- **A rise in sea levels resulting in the displacement of coastal businesses and residences.** During the past century, sea levels along California's coast have risen about seven inches. If emissions continue unabated and temperatures rise into the higher anticipated warming range, sea level is expected to rise an additional 22 to 35 inches by the end of the century. Elevations of this magnitude would inundate coastal areas with salt water, accelerate coastal erosion, threaten vital levees and inland water systems, and disrupt wetlands and natural habitats.

- **An increase temperature and extreme weather events.** Climate change is expected to lead to increases in the frequency, intensity, and duration of extreme heat events and heat waves in California. More heat waves can exacerbate chronic disease or heat-related illness.
- **A decrease in the health and productivity of California's forests.** Climate change can cause an increase in wildfires, an enhanced nuisance insect population, and establishment of non-native species.
- **Damage to marine ecosystems and natural environment.** Climate change can cause damage to marine ecosystems, including acidification of the oceans due to increased CO_2 levels (including coral bleaching).

Los Angeles Region

In addition to Statewide projections, *California's Fourth Climate Change Assessment* includes regional reports that summarize climate impacts and adaptation solutions for nine regions of the state as well as regionally-specific climate change case studies, including for the greater Los Angeles region that includes western Riverside County where the UCR main campus is located. Below is a summary of some of the potential effects that could be experienced in California and the Los Angeles region because of climate change (California 2018b).

In the Los Angeles region, climate change may impact the following aspects:

- **Air Quality.** In the Los Angeles region, changes in meteorological conditions under climate change will affect future air quality. Regional stagnation conditions may occur more often in the future, which would increase pollutant concentrations. Hotter future temperatures will act to increase surface ozone concentrations both due to chemistry producing more ozone and higher rates of biogenic emissions, while increases of water vapor also influence chemistry by increasing ozone production in already polluted areas.
- **Water Supply.** Like the rest of the State, the Los Angeles region is expected to face a challenging combination of decreased water supply and increased water demand. Greater interannual variability of rainfall and sharp decreases in snowpack will create surface water limitations for the region. Although the effect of climate change on average precipitation in the region is still unclear, more frequent occurrences of extreme events similar to the 2011-2016 drought could significantly decrease groundwater recharge, which is essential for the sustainability of agriculture in the region since the vast majority of water used in agriculture in the region is groundwater from local wells. Furthermore, higher temperatures mean that dry years will more quickly develop into severe drought conditions.
- **Hydrology and Sea Level Rise.** In the Los Angeles region, despite small changes in average precipitation, dry and wet extremes are both expected to increase. By the late 21st century, the wettest day of the year is expected to increase across most of the region. Increased frequency and severity of atmospheric river events are also projected to occur for this region.
- **Agriculture.** In the Los Angeles region, more frequent droughts could significantly decrease groundwater recharge and therefore impact agricultural operations that use groundwater from local wells. This and other climate effects can contribute to higher food prices and shortages. In addition, pest and disease issues with crops are anticipated to increase.
- **Ecosystems and Wildfire.** Many of the impacts identified above would impact ecosystems and wildlife in the Los Angeles region. Increases in wildfire would further remove sensitive habitat; increased severity in droughts would potentially starve plants and animals of water; and sea level rise will affect sensitive coastal ecosystems (California 2018b).

4.8.2 Regulatory Setting

Additional regulatory information related to GHG emissions are included throughout the other resource chapters including Section 4.17, *Utilities and Service Systems*, which includes discussion of water use efficiency standards, solid waste standards, and wastewater standards, Section 4.3, *Air Quality*, which includes discussion of air quality related regulations, and Section 4.6, *Energy*, which includes discussion of additional energy efficiency requirements.

International

Paris Climate Change Agreement

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached an agreement on December 12, 2015 in Paris, charting a new course in the global climate effort. The treaty commits member countries to put forward their best efforts and to strengthen them in the years ahead, including requirements that all parties report regularly on their emissions and implementation efforts, and undergo international review. The agreement and a companion decision by parties, known as the 21st session of the UNFCCC Conference of the Parties, or "COP 21" were the key outcomes that reaffirmed the goal of limiting global temperature increase below 2°C while urging efforts to limit the increase to 1.5°C and established binding commitments by all parties to make nationally determined contribution and to pursue domestic measures aimed at achieving them.

Federal

Clean Air Act (Regulation of GHGs)

The United States Environmental Protection Agency (US EPA) issued an Endangerment Finding under Section 202(a) of the Clean Air Act, opening the door to federal regulation of GHGs. The Endangerment Finding notes that GHGs threaten public health and welfare and are subject to regulation under the Clean Air Act. To date, the US EPA has not promulgated regulations on GHG emissions, but it has already begun to develop them.

Federal Fuel Efficiency Standards (CAFE)

Under the Clean Air Act, corporate average fuel economy (CAFE) standards have been set for passenger cars and light trucks. The State of California has traditionally had a waiver to set its own more stringent fuel efficiency standards. However, on August 2, 2018, the NHTSA and US EPA, operating under the direction of the Trump Administration, proposed the Safer Affordable Fuel-Efficient Vehicles Rule (SAFE Rule). This rule addresses emissions and fuel economy standards for motor vehicles and is separated in two parts as described below.

- Part One, "One National Program" (84 FR 51310) revokes a waiver granted by US EPA to the State of California under Section 209 of the CAA to enforce more stringent emission standards for motor vehicles than those required by US EPA for the explicit purpose of GHG reduction, and indirectly, criteria air pollutants and ozone precursor emission reduction. This revocation became effective on November 26, 2019, potentially restricting the ability of CARB to enforce more stringent GHG emission standards for new vehicles and set zero emission vehicle mandates in California.

- Part Two addresses CAFE standards for passenger cars and light trucks for model years 2021 to 2026. This rulemaking proposes new CAFE standards for model years 2022 through 2026 and would amend existing CAFE standards for model year 2021. The proposal would retain the model year 2020 standards (specifically, the footprint target curves for passenger cars and light trucks) through model year 2026. The proposal addressing CAFE standards was jointly developed by NHTSA and US EPA, with US EPA simultaneously proposing tailpipe CO_2 standards for the same vehicles covered by the same model years.

EPA and NTHSA published final rules to amend and establish national CO2 and fuel economy standards on April 30, 2020 (Part Two of the SAFE Vehicles Rule) (85 FR 24174). California and 22 other states are currently challenging this new rule in the court system, and it is reasonably foreseeable that the State will be successful in its legal challenges, for the reasons outlined in the State's lawsuit[9] and on the CARB website (CARB 2021). Furthermore, on January 20, 2021, President Biden signed an executive order directing the Government to revise fuel economy standards with the goal of further reducing emissions (US White House 2021). In February 2021, the Biden administration Department of Justice also asked courts to put the litigation on hold while the administration "reconsidered the policy decisions of a prior administration." Most Recently, on April 22, 2021, the Biden Administration formally proposed to roll back portions of the SAFE Rule, thereby restoring California's right to enforce more stringent fuel efficiency standards (USDOT 2021).

It is, however, legally infeasible for individual agencies, in this case the UC system, to adopt more stringent fuel efficiency standards for commuter vehicles. The CAA (42 United States Code [USC] Section 7543[a]) states that "no State or any political subdivision therefore shall adopt or attempt to enforce any standard relating to the control of emissions from new motor vehicles or new motor vehicle engines subject to this part." Therefore, UCR students and faculty abide by federal and State transportation fuel efficiency standards related to commuter vehicles.

Construction Equipment Fuel Efficiency Standard

US EPA sets emission standards for construction equipment. The first federal standards (Tier 1) were adopted in 1994 for all off-road engines over 50 horsepower (hp) and were phased in by 2000. A new standard was adopted in 1998 that introduced Tier 1 for all equipment below 50 hp and established the Tier 2 and Tier 3 standards. The Tier 2 and Tier 3 standards were phased in by 2008 for all equipment. The current iteration of emissions standards for construction equipment are the Tier 4 efficiency requirements are contained in 40 Code of Federal Regulations Parts 1039, 1065, and 1068 (originally adopted in 69 Federal Register 38958 [June 29, 2004], and most recently updated in 2014 [79 Federal Register 46356]). Emissions requirements for new off-road Tier 4 vehicles were to be completely phased in by the end of 2015.

U.S. Consolidated Appropriations Act (Mandatory GHG Reporting)

The Consolidated Appropriations Act, passed in December 2007, required the establishment of mandatory GHG reporting requirements. In September 22, 2009, the US EPA issued the Final Mandatory Reporting of Greenhouse Gases Rule, which became effective January 1, 2010. The rule requires reporting of GHG emissions from large sources and suppliers in the U.S, and is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that

[9] *State of California et al. v. Chao et al.* (Case 1:19-cv-02826) available at: https://oag.ca.gov/system/files/attachments/press_releases/California%20v.%20Chao%20complaint%20%2800000002%29.pdf

emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to the US EPA. The first annual reports for the largest emitting facilities, covering calendar year 2010, were submitted to US EPA in 2011.

State

Assembly Bill 1493 (Pavley Regulations and Fuel Efficiency Standards)

AB 1493 (2002), California's Advanced Clean Cars program (referred to as Pavley), requires CARB to develop and adopt regulations to achieve "the maximum feasible and cost-effective reduction of GHG emissions from motor vehicles." On June 30, 2009, US EPA granted the waiver of the Clean Air Act preemption to California for its GHG emission standards for motor vehicles beginning with the 2009 model year. Pavley I regulates model years from 2009 to 2016, and Pavley II, which is now referred to as "Low Emission Vehicle (LEV) III GHG", regulates model years from 2017 to 2025. The Advanced Clean Cars program coordinates the goals of the LEV, Zero Emissions Vehicles (ZEV), and Clean Fuels Outlet programs, and would provide major reductions in GHG emissions. By 2025, when the rules will be fully implemented, new automobiles will emit 34 percent fewer GHGs and 75 percent fewer smog-forming emissions from their model year 2016 levels.

Executive Order B-48-18: Zero-Emission Vehicles

On January 26, 2018, Governor Brown signed Executive Order B-48-18 requiring all State entities to work with the private sector to have at least 5 million zero-emission vehicles (ZEVs) on the road by 2030, as well as install 200 hydrogen fueling stations and 250,000 electric vehicle (EV) charging stations by 2025. It specifies that 10,000 of the EV charging stations should be direct current fast chargers. This order also requires all State entities to continue to partner with local and regional governments to streamline the installation of ZEV infrastructure. The Governor's Office of Business and Economic Development is required to publish a Plug-in Charging Station Design Guidebook and update the 2015 Hydrogen Station Permitting Guidebook to aid in these efforts. All State entities are required to participate in updating the 2016 Zero-Emissions Vehicle Action Plan, along with the 2018 ZEV Action Plan Priorities Update, which includes and extends the 2016 ZEV Action Plan (Governor's Interagency Working Group on Zero-Emission Vehicles 2016, 2018), to help expand private investment in ZEV infrastructure with a focus on serving low-income and disadvantaged communities. The quantitative GHG analysis below is conservative as GHG benefits of this order have not been modeled.

Executive Order N-79-20

Governor Gavin Newsom signed Executive Order N-79-20 in September 2020, which sets a Statewide goal that 100 percent of all new passenger car and truck sales in the State will be zero-emissions by 2035. It also sets a goal that 100 percent of statewide new sales of medium- and heavy-duty vehicles will be zero emissions by 2045, where feasible, and for all new sales of drayage trucks to be zero emissions by 2035. Additionally, the Executive Order targets 100 percent of new off-road vehicle sales in the State to be zero emission by 2035. CARB is responsible for implementing the new vehicle sales regulation. The quantitative GHG analysis below is conservative as GHG benefits of this order have not been modeled.

Assembly Bill 32 (Global Warming Solutions Act and Scoping Plan)

California's major initiative for reducing GHG emissions is outlined in Assembly Bill (AB) 32, the "California Global Warming Solutions Act of 2006," which was signed into law in 2006. AB 32 codifies the statewide goal of reducing GHG emissions to 1990 levels by 2020 and requires CARB to prepare a Scoping Plan that outlines the main State strategies for reducing GHGs to meet the 2020 deadline. In addition, AB 32 requires CARB to adopt regulations to require reporting and verification of statewide GHG emissions. Based on this guidance, CARB approved a 1990 Statewide GHG level and 2020 limit of 427 million $MTCO_2e$. The Scoping Plan was approved by CARB on December 11, 2008 and included measures to address GHG emission reduction strategies related to energy efficiency, water use, and recycling and solid waste, among other measures. Many of the GHG reduction measures included in the Scoping Plan (e.g., Low Carbon Fuel Standard, Advanced Clean Car standards, and Cap-and-Trade) have been adopted since approval of the Scoping Plan.

In May 2014, CARB approved the first update to the AB 32 Scoping Plan. The 2013 Scoping Plan Update defined CARB's climate change priorities for the next five years and set the groundwork to reach post-2020 Statewide goals. The 2013 Scoping Plan Update highlighted California's progress toward meeting the 2020 GHG emission reduction goals defined in the original Scoping Plan. It also evaluated how to align the State's longer-term GHG reduction strategies with other State policy priorities, including those for water, waste, natural resources, clean energy, transportation, and land use. The State of California achieved its 2020 GHG emission reduction targets in 2016, and emissions have subsequently fallen further in 2018 to 425 $MMTCO_2e$ (CARB 2020).

Senate Bill 32 (Global Warming Solutions Act and Scoping Plan Extension)

Senate Bill (SB) 32 signed into law on September 8, 2016, tightens the requirements of AB 32 by requiring the State to further reduce GHGs to 40 percent below 1990 levels by 2030 (the other provisions of AB 32 remain unchanged). On December 14, 2017, CARB adopted the 2017 Scoping Plan, which provides a framework for achieving the 2030 target. The 2017 Scoping Plan relies on the continuation and expansion of existing policies and regulations, such as the Cap-and-Trade Program, as well as implementation of recently adopted policies, such as SB 350 and SB 1383. The 2017 Scoping Plan also puts an increased emphasis on innovation, adoption of existing technology, and strategic investment to support its strategies. As with the 2013 Scoping Plan Update, it recommends that local governments adopt policies consistent with statewide per capita goals of 6 $MTCO_2e$ by 2030 and 2 $MTCO_2e$ by 2050. As stated in the 2017 Scoping Plan, these goals may be appropriate for plan-level analyses (city, county, subregional, or regional level).

CARB Cap-and-Trade Regulation

In 2011, CARB adopted the cap-and-trade regulation and created the cap-and-trade program, which covers sources of GHG emissions that emit more than 25,000 $MTCO_2e$ per year in the State such as refineries, power plants, industrial facilities, and transportation fuels. The cap-and-trade program includes an enforceable State-wide GHG emissions cap that declines approximately three percent annually. CARB distributes allowances, which are tradable permits, equal to the emissions allowed under the cap. Sources that reduce emissions more than their limits can auction carbon allowances to other covered entities through the cap-and-trade market. Sources subject to the cap are required to surrender allowances and offsets equal to their emissions at the end of each compliance period. The cap-and-trade program took effect in early 2012 with the enforceable compliance obligation beginning January 1, 2013. The cap-and-trade program was initially slated to sunset in 2020 but the passage of SB 398 in 2017 extended the program through 2030.

The UCR campus is subject to cap-and-trade and participates in the program. UCR is designated as an abbreviated reporter under the cap-and-trade program due to the fact that the GHG emissions are below the 25,000 MTCO2e per year threshold.

Senate Bill 100 (100 Percent Clean Energy Act)

Adopted on September 10, 2018, SB 100 supports the reduction of GHG emissions from the electricity sector by accelerating the State's Renewables Portfolio Standard Program, which was last updated by SB 350 in 2015. SB 100 requires electricity providers to increase procurement from eligible renewable energy resources to 33 percent of total retail sales by 2020, 60 percent by 2030, and 100 percent by 2045. As described in greater detail in the Section 4.6, *Energy*, UCR's power provider produced approximately 34 percent of its power from renewable resources in 2018, and that number was anticipated to increase to 44 percent by 2020.

Senate Bill 375 (Sustainable Communities and Climate Protection Act)

SB 375, signed in August 2008, enhances the State's ability to reach AB 32 goals by directing CARB to develop regional GHG emission reduction targets to be achieved from passenger vehicles by 2020 and 2035. In addition, SB 375 directs each of the State's 18 major Metropolitan Planning Organizations (MPOs) to prepare a "sustainable communities strategy" (SCS) that contains a growth strategy to meet these emission targets for inclusion in the Regional Transportation Plan (RTP). On March 22, 2018, CARB adopted updated regional targets for reducing GHG emissions from 2005 levels by 2020 and 2035. Southern California Association of Governments (SCAG) was assigned targets of an 8 percent reduction in GHGs from transportation sources by 2020 and a 19 percent reduction in GHGs from transportation sources by 2035. In the SCAG region, SB 375 also provides the option for the coordinated development of subregional plans by the subregional councils of governments and the county transportation commissions to meet SB 375 requirements.

Executive Order B-55-18

On September 10, 2018, Governor Brown issued Executive Order B-55-18, which established a new Statewide goal of achieving carbon neutrality by 2045 and maintaining net negative GHG emissions thereafter. This goal is in addition to the existing Statewide GHG reduction targets established by SB 32, SB 100, SB 375, and SB 1383. University of California, as a State entity, is committed to its fair share of reduction measures in support of achieving carbon neutrality by 2045. See University of California regulations below.

Senate Bill 97 and CEQA Guidelines Update

SB 97, signed in August 2007, acknowledges that climate change is an environmental issue that requires analysis in CEQA documents. In March 2010, the California Natural Resources Agency adopted amendments to the CEQA Guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions. The adopted guidelines give lead agencies the discretion to set quantitative or qualitative thresholds for the assessment and mitigation of GHG and climate change impacts.

CARB Innovative Clean Transit Regulations

In December 2018, the CARB adopted the Innovative Clean Transit regulations, requiring all transit agencies to develop a plan to achieve zero emission bus fleets on or before 2040. Starting between

2023 and 2029, transit agencies must begin purchasing only ZEB replacements and must have completed the fleet replacement program prior to 2040.

California Code of Regulations Title 24 (California Building Code)

Updated every three years through a rigorous stakeholder process, Title 24 of the California Code of Regulations requires California homes and businesses to meet strong energy efficiency measures, thereby lowering their energy use. Title 24 contains numerous subparts, including Part 1 (Administrative Code), Part 2 (Building Code), Part 3 (Electrical Code), Part 4 (Mechanical Code), Part 5 (Plumbing Code), Part 6 (Energy Code), Part 8 (Historical Building Code), Part 9 (Fire Code), Part 10 (Existing Building Code), Part 11 (Green Building Standards Code), Part 12 (Referenced Standards Code). The California Building Code is applicable to all development in California. (Health and Safety Code §§ 17950 and 18938(b).)

The regulations receive input from members of industry, as well as the public, with the goal of "[r]educing of wasteful, uneconomic, inefficient, or unnecessary consumption of energy." (Pub. Res. Code § 25402.) These regulations are scrutinized and analyzed for technological and economic feasibility (Pub. Res. Code § 25402(d)) and cost effectiveness (Pub. Res. Code § 25402(b)(2) and (b)(3)).

PART 6 – BUILDING ENERGY EFFICIENCY STANDARDS

CCR Title 24 Part 6 is the Building Energy Efficiency Standards. This code, originally enacted in 1978, establishes energy-efficiency standards for residential and non-residential buildings in order to reduce California's energy demand. The Building Energy Efficiency Standards is updated periodically to incorporate and consider new energy-efficiency technologies and methodologies as they become available. New construction and major renovations must demonstrate their compliance with the current Building Energy Efficiency Standards through submission and approval of a Title 24 Compliance Report to the local building permit review authority and the California Energy Commission. Under the 2019 standards, nonresidential buildings will be 30 percent more energy efficient compared to the 2016 standards, and residential buildings will be 7 percent more energy efficient. When accounting for the electricity generated by the solar photovoltaic system, residential buildings would use 53 percent less energy compared to buildings built to the 2016 standards.

The 2019 Building Energy Efficiency Standards, adopted on May 9, 2018, became effective on January 1, 2020. The 2019 Standards move toward cutting energy use in new residential units by more than 50 percent and will require installation of solar photovoltaic systems for single-family homes and multi-family buildings of three stories and less. The 2019 Standards focus on four key areas: 1) smart residential photovoltaic systems; 2) updated thermal envelope standards (preventing heat transfer from the interior to exterior and vice versa); 3) residential and nonresidential ventilation requirements; 4) and nonresidential lighting requirements. Under the 2019 Standards, non-residential buildings will be 30 percent more energy-efficient compared to the 2016 Standards, and single-family homes will be seven percent more energy efficient.

PART 11 – CALIFORNIA GREEN BUILDING STANDARDS

The California Green Building Standards Code, referred to as CALGreen, was added to CCR Title 24 as Part 11 first in 2009 as a voluntary code, which then became mandatory effective January 1, 2011 (as part of the 2010 CBC). The 2019 CALGreen institutes mandatory minimum environmental performance standards for all ground-up new construction of non-residential and residential structures. It also includes voluntary tiers (I and II) with stricter environmental performance

standards for these same categories of residential and non-residential buildings. Local jurisdictions must enforce the minimum mandatory Green Building Standards and may adopt additional amendments for stricter requirements.

Mandatory standards require:

- 20 percent reduction in indoor water use relative to specified baseline levels;
- 50 percent construction/demolition waste diverted from landfills;
- Inspections of energy systems to ensure optimal working efficiency;
- Low-pollutant emitting exterior and interior finish materials such as paints, carpets, vinyl flooring, and particleboards; and
- Installation of EV charging stations at least three percent of the parking spaces for all new multi-family developments with 17 or more units.

Similar to the compliance reporting procedure for demonstrating Building Energy Efficiency Standards compliance in new buildings and major renovations, compliance with the CalGreen water-reduction requirements must be demonstrated through completion of water use reporting forms for new low-rise residential and non-residential buildings. Buildings must demonstrate a 20 percent reduction in indoor water use by either showing a 20 percent reduction in the overall baseline water use as identified in CalGreen or a reduced per-plumbing-fixture water use rate.

Senate Bill 1383 (Short-lived Climate Pollutants)

Adopted in September 2016, SB 1383 requires the CARB to approve and begin implementing a comprehensive strategy to reduce emissions of short-lived climate pollutants. The bill requires the strategy to achieve the following reduction targets by 2030:

- Methane – 40 percent below 2013 levels
- Hydrofluorocarbons – 40 percent below 2013 levels
- Anthropogenic black carbon – 50 percent below 2013 levels

Assembly Bill 341/Assembly Bill 1826 (Mandatory Recycling/Composting)

The California Integrated Waste Management Act of 1989, as modified by AB 341, requires each jurisdiction's source reduction and recycling element to include an implementation schedule that shows diversion away from landfills of 75 percent of all solid waste by 2020 and annually thereafter. AB 1826 requires recycling of organic waste (i.e., composting). All businesses and public entities that generate four or more cubic yards of solid waste per week and multi-family residential dwellings that have five or more units are required to recycle and compost.

California Model Water Efficient Landscape Ordinance

The revised Model Water Efficient Landscape Ordinance became effective on December 15, 2015. New development that includes landscaped areas of 500 square feet or more are subject to the following revised Ordinance requirements:

- More efficient irrigation systems
- Incentives for graywater usage
- Improvements in on-site stormwater capture
- Limiting the portion of landscapes that can be planted with high water use plants

- Reporting requirements for local agencies.

University of California

UC Policy on Sustainable Practices

UC's official sustainability commitment began in 2003 with a Regental action that led to the adoption of a Presidential Policy on Green Building Design and Clean Energy Standards in 2004. Since adopting that policy, UC expanded its sustainability policies to address climate protection, transportation, building operations, waste, procurement, food, water, and health care facilities. The policy was subsequently renamed the *UC Policy on Sustainable Practices*, which is updated periodically. In the 2007 revision of the *UC Policy on Sustainable Practices*, the University of California Office of the President (UCOP) committed UC to implementing actions to achieve a reduction in GHG emissions from UC operations and activities to 2000 levels by 2014 and 1990 levels by 2020. UC's official commitment to sustainability across the above-listed sectors is integrated into the *UC Policy on Sustainable Practices* updated in July 2020 (UC 2020). The *UC Policy on Sustainable Practices* states that each campus and the UCOP will develop strategies for meeting the following UC goals:

- Policy C.1: Climate neutrality from Scope 1 and Scope 2 sources by 2025
- Policy C.2: Climate neutrality from specific Scope 3 sources (as defined by Second Nature's Carbon Commitment) by 2050 or sooner

In addition, the following UCR existing GHG emissions reduction policies pertain to operations that are within the operational control of UCR and set specific, quantitative standards. The following policies are noted from the *UC Policy on Sustainable Practices*:

- Policy A.1: All new building projects, other than acute care facilities, shall be designed, constructed, and commissioned to outperform the CBC energy-efficiency standards by at least 20 percent or meet the whole-building energy performance targets listed in Table 1 of Section V.A.3 of the *UC Policy on Sustainable Practices*. The University will strive to design, construct, and commission buildings that outperform CBC energy efficiency standards by 30 percent or more, or meet the stretch whole-building energy performance targets listed in Table 1 of Section V.A.3 of the *UC Policy on Sustainable Practices*, whenever possible within the constraints of program needs and standard budget parameters.
- Policy A.3: No new building or major renovation that is approved after June 30, 2019 shall use on-site fossil fuel combustion (e.g., natural gas) for space and water heating (except those projects connected to an existing campus central thermal infrastructure). Projects unable to meet this requirement shall document the rationale for this decision as described in Section V.A.4 of the *UC Policy on Sustainable Practices*.
- Policy A.4: All new buildings will achieve a U.S. Green Building Council (USGBC) LEED "Silver" certification at a minimum. All new buildings will strive to achieve certification at a USGBC LEED "Gold" rating or higher, whenever possible within the constraints of program needs and standard budget parameters.
- Policy A.5: The University of California will design, construct, and commission new laboratory buildings to achieve a minimum of LEED "Silver" certification as well as meeting at least the prerequisites of the Laboratories for the 21st Century (Labs21) Environmental Performance Criteria (EPC). Laboratory spaces in new buildings also shall meet at least the prerequisites of

Labs21 EPC. Design, construction, and commissioning processes shall strive to optimize the energy efficiency of systems not addressed by the CBC energy efficiency standards.

- Policy A.7: Major Renovations of buildings are defined as projects that require 100 percent replacement of mechanical, electrical, and plumbing systems and replacement of over 50 percent of all non-shell areas (interior walls, doors, floor coverings, and ceiling systems) shall at a minimum comply with III.A.4 or III.A.5, above. Such projects shall outperform CBC Title 24, Part 6, currently in effect, by 20 percent. This does not apply to acute care facilities.
- Policy A.8: Renovation projects with a project cost of $5 million or greater that do not constitute a Major Renovation as defined in Policy A.7 shall, at a minimum, achieve a LEED-ID+C Certified rating and register with the utilities' Savings by Design program, if eligible. This does not apply to acute care facilities.
- Policy B.1: Each location will implement energy efficiency actions in buildings and infrastructure systems to reduce the location's energy use intensity by an average of least 2 percent annually.
- Policy B.2: Campuses and health care locations will install additional on-site renewable electricity supplies and energy storage systems whenever cost-effective and/or supportive of the location's Climate Action Plan or other goals.
- Policy B.3: By 2025, each campus and health location will obtain 100 percent clean electricity. By 2018, the University's Wholesale Power Program will provide 100 percent clean electricity to participating locations.[10]
- Policy B.4: By 2025, at least 40 percent of the natural gas combusted on-site at each campus and health location will be biogas.
- Policy D.1: Each location will reduce GHG emissions from its fleet and report annually on its progress. Locations shall implement strategies to reduce fleet emissions and improve the fuel efficiency of all university-owned or operated fleet vehicles and equipment where practical options exist through acquisition and fleet operation protocols.
  - By 2025, zero-emission vehicles or hybrid vehicles shall account for at least 50 percent of all new light-duty vehicle acquisitions. Lawrence Berkeley National Laboratory will follow federal fleet requirements in the case where federal and UC fleet requirements conflict.
- Policy D.2: The University recognizes that single-occupant vehicle (SOV) commuting is a primary contributor to commute GHG emissions and localized transportation impacts.
  - By 2025, each location shall strive to reduce its percentage of employees and students commuting by SOV by 10 percent relative to its 2015 SOV commute rates;
  - By 2050, each location shall strive to have no more 40 percent of its employees and no more than 30 percent of all employees and students commuting to the location by SOV.
- Policy D.3: Consistent with the State of California goal of increasing alternative fuel – specifically electric – vehicle usage, the University shall promote purchases and support investment in alternative fuel infrastructure at each location.
  - By 2025, each location shall strive to have at least 4.5 percent of commuter vehicles be ZEV.
  - By 2050, each location shall strive to have at least 30 percent of commuter vehicles be ZEV.
- Policy D.4: Each location will develop a business-case analysis for any proposed parking structures serving University affiliates or visitors to campus to document how a capital investment in parking aligns with each campus' Climate Action Plans and/or sustainable transportation policies.

[10] UCR is not currently a participating location under the Wholesale Power Program.

- Policy F.1: The University will achieve zero waste[11] through prioritizing waste reduction in the following order: reduce, reuse, and then recycle and compost (or other forms of organic recycling) as described in Section V.F.6 of the *UC Policy on Sustainable Practices*. Minimum compliance for zero waste, at all locations other than health locations, is as follows:
  - Reduce per capita total municipal solid waste generation by:
    - 25 percent per capita from FY2015/16 levels by 2025.
    - 50 percent per capita from FY2015/16 levels by 2030.
  - Divert 90 percent of municipal solid waste from the landfill.
- Policy F.2: The University supports the integration of waste, climate, and other sustainability goals, including the reduction of embodied carbon in the supply chain through the promotion of a circular economy and the management of organic waste to promote atmospheric carbon reduction. In support of this goal, waste reporting will include tracking estimated Scope 3 GHG emissions (UC 2020).

UCR Transportation Demand Management

UCR's Transportation Demand Management (TDM) programs include multi-pronged efforts such as marketing, incentives, expanded vanpool offerings, on- and near-campus housing amenities, parking pricing, and more. UCR encourages students to use designated bike paths to commute to and travel within the campus. Registered bicyclists or walkers are eligible to receive a complimentary bicycle parking allotment and are eligible to utilize the day-use locker and shower facilities at the SRC without charge. UCR has also encouraged ride-sharing services, and the average vehicle ridership has increased from approximately 1.36 to 1.57 occupants per vehicle over the last 15 years. However, it is legally infeasible to mandate ridesharing. (See Health and Safety Code § 40717.9; *Merced Alliance for Responsible Growth v. City of* Merced 2012 WL 5984917.) The quantitative GHG analysis below is conservative as GHG benefits of future improvements to TDM use have not been modeled.

Regional and Local (Non-Binding)

As noted in Section 4, "University of California Autonomy," UCR, a constitutionally created State entity, is not subject to municipal regulations of surrounding local governments for uses on property owned or controlled by UCR that are in furtherance of the university's educational purposes. However, UCR may consider, for coordination purposes, aspects of local plans and policies of the communities surrounding the campus when it is appropriate and feasible, but not bound by those plans and policies in its planning efforts. No regional or local plans related to GHG emissions apply to the proposed 2021 LRDP.

4.8.3 Environmental Impacts and Mitigation Measures

Significance Criteria

UCR utilizes the following 2020 CEQA Guidelines Appendix G significance criteria questions related to GHG Emissions.

[11] The University zero waste goal is made up of incremental waste reduction and waste diversion targets. The University recognizes the attainment of reduction goals stated in this Policy and a 90 percent diversion of municipal solid waste as minimum compliance standard to be defined as a zero waste for locations other than health locations.

Would the proposed 2021 LRDP:

a) Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs?

Issues Not Evaluated Further

All issues applicable to GHG emissions listed under the CEQA significance criteria above are addressed in this section.

Analysis Methodology

GHG emissions for the proposed 2021 LRDP construction and operation were calculated with regard to the GHGs CO_2, N_2O, and CH_4, which are combined using each GHGs' GWP and reported as CO_2e. GHG emissions were modeled for energy, mobile, process/fugitive, and waste sources. The input data and construction and operation GHG emission estimates for proposed 2021 LRDP are discussed below and in Appendix G.

UCR has decided to utilize the following thresholds to determine whether the proposed 2021 LRDP would result in significant impacts related to GHG emissions under significance criterion "a":

- Generation of GHG emissions that would exceed 2018 baseline GHG emissions level.
- Generation of GHG emissions that would exceed *UC Policy on Sustainable Practices* requirement to meet Scope 1 and Scope 2 emissions carbon neutrality beginning January 1, 2026.
- Generation of GHG emissions that would exceed the GHG emission reduction efforts of the State in accordance with SB 32. Total emissions would be no greater than 40 percent below 1990 levels per year (e.g. 49,300 $MTCO_2e$ total emissions) by December 31, 2030.

The baseline threshold is consistent with CEQA Guidelines Section 15064.4(b)(1) and compares GHG emissions from the proposed 2021 LRDP to baseline GHG emissions and considers any increase in GHG emissions above baseline conditions to be significant.

The second and third thresholds were developed using science-based goals of the global reductions in emissions that would be needed in order to avoid dangerous climate change effects; these goals represent what can be described as California's—and by inference, UCR's—proportional reduction in emissions to avoid dangerous climate change. Per the CARB 2017 Scoping Plan, local governments can demonstrate consistency with Statewide targets by applying derived percentage reductions, necessary to reach determined future climate goals, to their community-wide GHG emissions target. For purposes of demonstrating consistency with State targets, UCR can be considered a local government, as it has functions similar to a self-contained small city, with housing, jobs, and cultural facilities offered in a built community. Furthermore, UCR has jurisdiction over campus land uses and provides core public services. Although the 2017 Scoping Plan also gave local jurisdictions the option of using per-capita or per-service-population targets, UCR has decided to use the relative percent reduction of total emissions in line with State and UC targets as its threshold. As such, these thresholds are consistent with 2017 Scoping Plan recommendation for assessing plan-level contribution impacts to global climate change. Compliance with the *UC Policy on Sustainable Practices* would result in campus-wide emissions reductions greater than the State targets under SB 32.

To determine whether the proposed 2021 LRDP would result in significant impacts related to GHG emissions under significance criterion "b," the following methodology would apply.

- Inconsistency with any of the following applicable plans for reduction of GHG emissions:
  - 2020 *UC Policy on Sustainable Practices*
  - SB 32 and CARB 2017 Scoping Plan

Construction Emissions

Construction-related GHG emissions were calculated using the California Emissions Estimator Model (CalEEMod) Version 2016.3.2 modeling tool. Modeling was based on 2021 LRDP buildout information (e.g., land use types, traffic modeling, amount of new building space) and default values in CalEEMod that are based on location, land use type, and typical construction activities. CalEEMod accounts for a variety of State, federal, and local programs and policies that affect construction-related emissions, such as local air district rules on architectural coatings and federal emission standards for off-road equipment, but these regulations primarily affect emissions of criteria pollutants. Additional information on CalEEMod, including the user guide, defaults, and appendices are available online at: http://www.caleemod.com/.

Due to the programmatic nature of this analysis, the timing of construction activities for all projects anticipated during implementation of the proposed 2021 LRDP cannot be predicted. UCR has developed a list of buildings and the associated building square footage that are anticipated to be demolished in 5 to 10 years (total of 557,826 gsf) [12] and 10 to 15 years (total of 327,453 gsf).[13] Emissions associated with these planned demolition actions were calculated via CalEEMod. Similarly, emissions associated with construction of new buildings were calculated using building square footage provided by UCR, and CalEEMod defaults based on the land use type. CalEEMod provides a number of default land use types such as University/College 4-Year, Library, and General Office Buildings that are representative of the UCR buildings to be constructed under the 2021 LRDP. Demolition and construction emissions were amortized across 2021 to 2035 and added to the forecasted emissions.

For a detailed description of construction emissions model input and output parameters, and assumptions, see the following supporting documents in Appendix G:

- Final GHG Inventory-Forecast Data Evaluation Memo
- Final GHG Inventory, Forecast, and Targets Report

[12] UCR estimates that in 5–10 years the following buildings will be demolished: Boyden Labs; Fawcett Laboratory; Stored Product Insecticide Building; Lathhouse #1; South Campus Drive Facilities and South District/Toe of the Hill south of South Campus Drive (Genomics shed, Bio Control Building, Plant Drying Building, Herbarium, Botany Screenhouse, Storage Shed #6, Headhouse Storage Building, Growth Chamber Building, Glasshouse #51, Lathhouses #4 and #8, Facilities Services Annex A, and College Building North and South); Northwest of East Campus Drive and north of Eucalyptus Drive, Northwest of East Campus Drive and south of Eucalyptus Drive, East of East Campus Drive and northeast of Eucalyptus Drive, East of East Campus Drive and southeast of Eucalyptus Drive, and East of East Campus Drive and southeast of Eucalyptus Drive (Fawcett Laboratory, University Office Building, Campbell Hall, Facilities Services Annex B, Greenhouses #7-14, Greenhouses #18-21, Computing & Communications Center, and associated accessory structures), Health Services Building (Veitch - Student Health Services), Bannockburn Village, Plaza Apartments, Corporation Yard, and Softball and soccer fields

[13] UCR estimates that in 10-15 years the following buildings will be demolished: Advanced Neuroimaging Building (formerly FMRI), Costo Hall, University Office Building, Police Facility, University Office Building, Oban Apartments, and Falkirk Apartments

Operational Emissions

ENERGY SOURCES

Energy-related operational emissions of GHGs (related to natural gas, diesel, and electricity consumption) for the existing main campus, interim projects, and new development under the proposed 2021 LRDP were calculated. In addition, operational energy-related GHG emissions account for ongoing operation of existing solar facilities on the main campus (see Section 4.6, *Energy*). Construction and operational GHG emissions associated with the interim[14] projects have been previously quantified in separate standalone UCR project-level CEQA documents using CalEEMod Version 2016.3.2, and the respective results have been provided by UCR for inclusion in the forecast. Construction and operational emissions were estimated using CalEEMod with the exception of the renovation projects (i.e., Batchelor Hall and Pierce Hall). Only operational emissions of GHG from energy use determined by CalEEMod was included for interim projects. All other operational emissions from new building construction under the proposed 2021 LRDP were forecasted from the 2018 inventory using specific growth factors discussed in detail in Appendix G. Indicator growth rates, such as energy per building square footage, gallons of fuel per campus population, VMT per campus population, or waste tons per campus population, were developed from 2018 activity levels and applied to the various emissions sectors to project future year emissions. Appendix G contains a complete list of the indicator growth factors used to develop the forecast for the proposed 2021 LRDP. The growth factors were then multiplied by the population or service person growth rates and anticipated building square footage growth in the proposed 2021 LRDP to develop the anticipated emissions forecast which is representative of future operational emissions.

Energy use from existing buildings (i.e., natural gas and electricity consumption) is based on the 2018 inventory and actual energy data provided by UCR from the respective electric utility and natural gas supplier, Riverside Public Utilities (RPU) and Shell Energy.[15] The proposed 2021 LRDP energy use was forecasted based on applying growth metrics, as described Appendix G, to the 2018 inventory energy use. The energy use intensity (EUI) factors from the UCR Program Concept Energy Analysis and building gross square footage provided by UCR were utilized to estimate annual natural gas and electricity use by building type for both existing buildings and future building.

Energy use for existing buildings was based on the EUI associated with the current level of energy performance at the time of the UCR Program Concept Energy Analysis, while energy use for future buildings was based on the EUI for the escalating California Title-24 code. Existing building EUIs in annual energy use (kBtu) by area (square feet) per year (kBtu/sf-yr) were determined for academic/admin, lab/complex, residential, and social building types to be 107, 253, 83 and 180 kBtu/sf-yr, respectively. New buildings built to code were determined in the UCR Program Concept Energy Analysis to have EUIs of 65, 149, 57 and 107 kBtu/sf-yr for academic/admin, lab/complex, residential, and social building types, respectively. UCR distinguished buildings by building or land use type allowing for the application of the appropriate EUI. EUIs for existing and future buildings were applied to the proposed 2021 LRDP buildings' gross square feet based on building type defined as either academic/admin, lab/complex, residential, or social.

[14] There are several interim projects that have occurred or are in progress on the UCR main campus after the 2018 calendar year and, therefore, were not accounted for within the 2018 GHG inventory. However, these interim projects are included in the 2021 LRDP emissions for the purpose of CEQA impact analysis.
[15] Natural gas is transported to the UCR main campus by Southern California Gas and is procured through Shell Energy.

Additional energy use improvements resulting from other State legislation were incorporated under the legislative adjusted scenario. In addition, increases in the renewable mix of electricity generation sources due to the California Renewable Portfolio Standard and SB 350 are assumed to affect the emission factors in future years. The RPU emission factors in 2018 were adjusted for future years based on the current percentage (i.e., 34 percent) of renewable electricity sources in 2018 and the projected linear increase to 60 percent renewable sources by 2030 per SB 100 and 100 percent renewable by 2045.[16]

PROCESS AND FUGITIVE EMISSIONS

Process and fugitive emission sources include fugitive emissions associated with the process, transmission, and storage of other substances (e.g., refrigerants) that do not pass through a stack, vent, or exhaust point. For UCR operations, this includes use of refrigerants. Refrigerant data provided by UCR includes the refrigerants that have been added to the main campus system, then subtracts any refrigerant that is removed with recovery equipment and stored during repair and maintenance. The total refrigerant value is reported as the total amount added during the year, minus all refrigerant that is recovered and returned to the equipment after repair and maintenance. Emissions from refrigerants are calculated based on annual usage of refrigerant and the refrigerants GWP obtained from the US EPA *Emission Factors for Greenhouse Gas Inventories (*US EPA 2018). Refrigerants are high GWP compounds that are themselves the GHG and are not generated as a product of combustion. As such, there is no emission factor associated with refrigerants. A total of 390 pounds of refrigerants were emitted in 2018, composed of refrigerants R-22, R-134A, R-404A, R-407C and R-410A. As identified by UCR, R-407C was added and recovered outside of the proposed 2021 LRDP boundary and therefore, was excluded from the 2018 inventory. The 100-year GWP of each was used to calculate $MTCO_2e$ emissions. The UCR 2018 refrigerant use was divided by the 2018 building square footage to develop an indicator growth rate. It was assumed that future building growth would require the use of refrigerants to the same extent. Therefore, the refrigerant indicator growth rate was multiplied by the proposed 2021 LRDP anticipated building square footage to estimate emissions generated from refrigerant use at proposed 2021 LRDP buildout.

WASTE SOURCES

GHG emissions from waste generation for the proposed 2021 LRDP were forecasted through 2035 based on full build out. The 2018 inventory waste generation per person was multiplied by the proposed 2021 LRDP anticipated population to estimate waste generation. This analysis is, therefore, considered conservative as it does not account for increasing solid waste diversion rates, which are estimated to increase from 70 percent to 90 percent due to UCOP policies, as described in greater detail in Section 4.17, *Utilities and Service Systems*.

MOBILE SOURCES

Mobile source emissions from UCR include emissions from UCR vehicle fleet emissions as well as VMT emissions associated with student, faculty, commercial vendor, and visitor populations.

With respect to non-UCR fleet, non-transit mobile sources, EMission FACtors (EMFAC) 2017 was used to estimate GHG emissions from vehicle miles traveled (VMT) generated by implementation of the proposed 2021 LRDP (refer to Section 4.15, *Transportation*). The modeled emission factors reflect the average vehicle mix and usage rates forecast for Riverside County in 2035, which is the proposed 2021 LRDP horizon year. Daily VMT were adjusted to annual VMT using a conversion

[16] 2018 Power content label for RPU indicated an emission factor of 0.428 $MTCO_2e/MWh$.

factor of 315 days, which accounts for UCR's academic schedule, holidays, and enrollment levels during summer and regular academic quarters. VMT modeling was based on specific proposed 2021 LRDP information (e.g., land use types, traffic modeling, building space) and outputs of the current version of the Riverside Transportation Analysis Model (RivTAM), a regional version consistent with the SCAG transportation model.

Emissions from UCR staff and student travel on transit systems were calculated based on the UCR population that rides bus transit lines that stop, originate, or terminate on the UCR campus. UCR provided ridership data for the Riverside Transit Agency (RTA) bus routes that are subsidized through the UPASS bus subsidy program. UPASS ridership data indicates the number of rides taken under a UPASS and affiliated with UCR. To attribute total emissions from RTA to UCR riders, the annual number of miles ridden by UPASS riders was estimated based on the average RTA passenger vehicle revenue miles (VRM).[17] Total emissions for the Rapid Link Gold Line, Route 1, Route 16, Route 51, Route 52, Route 204, Route 208 and Route 212 are calculated based on total VRMs traveled in 2018 (RTA 2019). Emissions factors for motor busses are obtained from EMFAC (CARB 2018). Based on 2018 ridership data, UCR students and staff rode an estimated 407,912 miles on RTA routes, which accounts for approximately 21 percent of all RTA VRMs in 2018.

Emission from fuel use by the UCR vehicle fleet were calculated by multiplying gallons of fuel consumed by fuel specific emissions factors obtained from CARB's EMFAC2017 model and emission factors from the US EPA *Emission Factors for Greenhouse Gas Inventories* (US EPA 2018; CARB 2018). Unleaded gasoline, compressed natural gas (CNG), and diesel are the fuels used by the vehicle fleet. In 2018, 135,192 gallons of unleaded gasoline, 4,321 gallon-equivalents of CNG, and 7,306 gallons of diesel were consumed for a total of 146,819 gallons of fuel used. Emission factors for CO_2, CH_4, and N_2O of emissions from each fuel type were sourced from The Climate Registry (The Climate Registry 2020). The emission factor for mobile combustion of gasoline fuel in the UCR vehicle fleet is 0.0088 $MTCO_2e$/gallon, 0.0067 $MTCO_2e$/gallon equivalents for CNG fueled vehicles, and 0.0102 $MTCO_2e$/gallon for diesel fueled vehicles.

For a detailed description of the aforementioned emissions model input and output parameters and assumptions, estimation of UCR 1990 emissions levels (82,167 $MTCO_2e$), quantification of 2018 baseline GHG emissions inventory, and forecasted 2025, 2030, 2035, 2040, and 2045 GHG emissions, as well as interpolation and translation of Statewide goals for determination of UCR-specific GHG emissions targets for these same years, see the following technical reports in Appendix G:

- Final GHG Inventory-Forecast Data Evaluation Memo
- Final GHG Inventory, Forecast, and Targets Report

2021 LRDP Objectives and Policies

The proposed 2021 LRDP contains objectives and policies relevant to GHG:

Mobility (M)

- Objective M1: Reduce future vehicular traffic, parking demand, and GHG emissions, by increasing student housing on campus up to 40 percent of the projected enrollment in 2035.

[17] A vehicle revenue mile is one vehicle traveling one mile with revenue passengers on board.

- Policy: Continue to grow and support on-campus residency by focusing on more affordable student housing options, as well as the capacity for returning students (upperclassmen) and graduate students.
- Promote public transit as a convenient and preferred mode of commuting to campus and connecting campus residents to the community and regional destinations.
- Policy: Develop the University Avenue and Canyon Crest Drive Gateway streetscapes to support increased use and functional efficiency of the RTA system, improved clarity of drop-off and pick-up locations for ride-sharing services, reduced conflict, and improved safety for cyclists, pedestrians, and emerging micro-mobility[18] solutions in these increasingly busy mixed-mode circulation areas.
- Policy: Improve access to public transit on campus by providing connectivity to access points via pathways or shuttles, as well as comfortable waiting facilities, proximate to commuter related services, where appropriate.
- Policy: Advocate and support the development of a Metrolink train platform along Watkins Drive adjacent to campus to provide direct access and significantly reduce commute times. Consider dedicated vanpools or shuttles to nearby stations in the interim.

- Objective M2: Invest in infrastructure to increase bicycle use and support other active transportation modes to integrate desired routes with the campus' and City's circulation framework.
  - Policy: Support and facilitate City-led initiatives to extend bikeways to campus from every direction, including routes proposed along Canyon Crest Drive, Martin Luther King Boulevard, and the Gage Canal.
  - Policy: Develop wayfinding systems to interconnect preferred bicycle routes and invest in safe and secure pathways along all bicycle routes.
  - Policy: Provide adequate support amenities to facilitate and encourage the use of bicycles and other alternative transportation modes.
  - Policy: Develop a comprehensive improvement plan for Campus Drive to improve function, safety and utility for each mode of travel, as incremental growth occurs.
- Objective M3: Emphasize safe and pleasing passage for pedestrians and bicycle riders through the careful, continued development and integration of the campus' multi-modal circulation framework and its extensions into the immediate community.
  - Policy: Identify and address gaps within the existing non-motorized circulation network, both on-campus and within the adjacent community.
  - Policy: Implement University policies to improve pedestrian safety and encourage social interaction in zones of high pedestrian activity.

Campus Utility Infrastructure (INF) – Energy (E)

- Objective INF E1: Prioritize redundancy and overall reliability in the campus' power distribution network.
  - Policy: Ensure infrastructure services and demands are regularly monitored and expanded as needed to meet applicable planned campus development.

[18] Micro-mobility is a category of modes of transport that are provided by very light vehicles such as electric scooters, electric skateboards, shared bicycles and electric pedal assisted bicycles. The primary condition for inclusion in the category is a gross vehicle weight of less than 500 kg.

- Objective INF E2: Emphasize high-performance new construction and building retrofits in support of the UC Policy on Sustainable Practices and minimize the need to purchase carbon offsets.
  - Policy: For mechanical systems in existing facilities, a 30 percent reduction in electrical energy use is projected, inclusive of a 30 percent reduction in electrical energy usage in existing facilities' mechanical systems.
  - Policy: Take the fullest possible advantage of RPU's clean energy plans and the City's "greening of the grid" initiatives.
  - Policy: Achieve a 5 percent improvement in energy performance for new building mechanical systems through retro-commissioning.
- Objective INF E3: Support alternative measures (e.g. alternative fuels, energy sources, practices, carbon offsets, etc.) and mixed energy source portfolios in support of green sustainability practices.
  - Policy: Continuously explore the potential to use alternative fuels over time as they become feasibly available.
  - Policy: Evaluate procurement options for alternative energy while considering long-term financial viability for the University.
  - Policy: Incorporate solar panels on the roofs of new construction to the maximum feasible extent.
  - Policy: Incorporate solar panels as integral elements of new construction design and applicable green building certifications to the maximum feasible extent.

Campus Utility Infrastructure (INF) – Natural Gas (NG)

- Objective INF NG1: Reduce reliance on natural gas in conformance with UC policies.
  - Policy: Future projects shall not employ or expand demand for natural gas as an energy source.
  - Policy: Continue to work with RPU and UCOP to reduce current natural gas demand through efficiency improvements to the existing system, conversion of steam boilers to electricity as they are replaced over time, and, rigorous pursuit of obtaining sources for biogas, or renewable energy credit purchases to fully offset GHG emissions in conformance with UC policies.
  - Policy: Take the fullest possible advantage of RPU's clean energy plans, and the City's "greening of the grid" initiatives.

Campus Utility Infrastructure (INF) – Potable Water, Wastewater and Irrigation (WWI)

- Objective INF WWI1: Commit to a multi-prong approach to conserving potable water use.
  - Policy: Reduce potable water use in an existing building in the Academic Center by 20 percent.
  - Policy: Reduce potable water use in student residential buildings by 30 percent.
  - Policy: Reduce potable water use in new facilities by exceeding applicable codes by a minimum of 20 percent.
  - Policy: Retrofit existing urinals, toilets, showerheads, and faucets for existing buildings with higher water efficiency rated equipment.

- Objective INF WWI2: Explore options to shift away from potable water use where feasible.
  - Policy: Design new building irrigation and efficient toilet flushing systems for use with future non-potable water sources.
  - Policy: Achieve a further 20 percent reduction of potable water use for irrigation by extending Gage Canal water to also irrigate the UCR Botanic Gardens, and reducing turf on campus and replacing with lower use landscaping.

Campus Sustainability (CS)

- Objective CS1: Continue to build on this commitment to environmental stewardship to account for the impacts of development and expansion of campus infrastructure. Major planning and policy issues of the University will be subject to include the following:
  - Policy: Carbon Neutrality Initiative: Carbon Neutral by 2025 – Climate neutrality from Scope 1 & Scope 2 sources by 2025.
  - Policy: Climate neutrality from specific Scope 3 sources by 2050 or sooner - At a minimum, meet the UC intermediate goal in pursuit of climate neutrality (See Assembly Bill [AB 32], and California Global Warming Solutions Act of 2006: emission limit [SB 32].
  - Policy: Energy Efficiency: UC Annual 2 percent Energy Use Intensity (EUI) Reduction Policy (Energy Efficiency) – Each location will implement energy efficiency actions in buildings and infrastructure systems to reduce the location's energy use intensity by an average of at least 2 percent annually.
  - Policy: On-Campus Renewable Electricity – Campuses and health locations will install additional on-site renewable electricity supplies and energy storage systems whenever cost-effective and/or supportive of the location's Climate Action Plan or other goals.
  - Policy: Off-Campus Clean Electricity: 100 percent Renewable Electricity by 2025 – By 2025, each campus and health location will obtain 100 percent clean electricity.
  - Policy: On-Campus Combustion – By 2025, at least 40 percent of the natural gas combusted on-site at each campus and health location will be biogas.

Impact Analysis

Impact GHG-1 Generate Greenhouse Gas Emissions that may have a Significant Impact on the Environment.

The proposed 2021 LRDP would generate GHG emissions, either directly or indirectly, that would have a significant impact on the environment. Impacts would be less than significant with the implementation of mitigation measures.

Construction Emissions

UCR's proposed 2021 LRDP and interim projects construction (and related demolition) are projected to generate a total of 22,654 $MTCO_2e$ between 2022 through 2035. When amortized over the 14-year proposed 2021 LRDP development period, construction emissions would be approximately 1,618 $MTCO_2e$ per year. See Appendix G for details related to construction emissions calculations.

Operational and Total Emissions

Table 4.8-3 shows the 1990 reference emissions, 2018 baseline emissions, and interim projects plus anticipated future GHG emissions generated by UCR in the years 2025, 2030, and 2035. The proposed 2021 LRDP is projected to result in 155,029 $MTCO_2e$ per year by 2035, which represents a net increase in campus-wide GHG emissions above 2018 baseline emissions caused by additional construction activity; on-road VMT; building energy consumption; waste emissions; and additional stationary source emissions. The calculations presented in Table 4.8-3 already account for emissions reductions from existing buildings and operations that are presumed to occur as a result of legislative requirements as the State electricity grid becomes more carbon neutral under SB 100 and as average vehicle emission rates decrease over time.[19,20]

The proposed 2021 LRDP GHG emissions under the future emissions forecast, which has been adjusted to account for applicable legislative reductions,[21] are projected to be:

- 139,920 $MTCO_2e$ per year by 2025
- 159,124 $MTCO_2e$ per year by 2030
- 155,029 $MTCO_2e$ per year by 2035

[19] Pursuant to SB 100 is assumed that RPU will procure 60% of electricity from a renewable source by 2030 and 100% by 2045. Renewably sources electricity is carbon neutral.
[20] The CARB EMFAC2017 transportation modeling program incorporates legislative requirements and regulations including Advanced Clean Cars program (Low Emissions Vehicles III, Zero Emissions Vehicles program, etc.), and Phase 2 federal GHG Standards.
[21] Legislative reductions include the mandatory requirements of SB 100, AB 1493, CBC Title 24 Parts 6 and 12, and CARB Innovative Clean Transit Regulations.

Table 4.8-3 Proposed 2021 LRDP GHG Emissions by Scope and Year

Scope	Reference Emissions – 1990[1] ($MTCO_2e$)	Baseline Emissions – 2018 ($MTCO_2e$)	2021 LRDP Emissions – 2025[2] ($MTCO_2e$)	2021 LRDP Emissions – 2030[2] ($MTCO_2e$)	2021 LRDP Emissions – 2035[2] ($MTCO_2e$)
Scope 1					
Natural Gas	–	18,410	32,526	43,056	53,702
Other Fuels	–	82	138	178	218
Building and Facility Refrigerants	–	339	569	734	899
UCR Fleet (Unleaded)	–	1,200	1,440	1,611	1,782
UCR Fleet (Diesel)	–	75	90	100	111
UCR Fleet (CNG)	–	30	36	40	44
Total Scope 1 Emissions	**17,535**	**20,136**	**34,798**	**45,719**	**56,756**
Scope 2					
Electricity	-	45,834	63,650	68,666	57,703
Total Scope 2 Emissions	**39,704**	**45,834**	**63,650**	**68,666**	**57,703**
Scope 3					
UCR Business Travel	–	1,562	1,943	2,215	2,487
On-Road Transportation (Passenger)	–	26,342	29,684	30,324	29,423
On-Road Transportation (Commercial/Heavy Duty)	–	2,372	3,121	3,624	3,135
Public Transit	–	743	608	453	251
Waste	–	244	293	328	362
2021 LRDP Demolition	–	0	44	44	44
2021 LRDP Construction	–	0	1,055	1,055	1,055
Interim Project Construction	–	–	1,820	0	0
Interim Project Operation	–	0	2,905	6,697	3,814
Total Scope 3 Emissions	**24,928**	**31,263**	**41,471**	**44,738**	**40,570**
Total Emissions[3]	**82,167**	**97,232**	**139,920**	**159,124**	**155,029**

Notes:

[1] 1990 emissions by scope were provided by UCR. Further breakdown by 1990 scope sub-sectors is not available.

[2] Interim project emissions are also included.

[3] Total numbers are rounded values therefore values may not add up exactly. Annual emissions may fluctuate year-over-year, dependent on true growth implemented under the proposed 2021 LRDP.

Source: Appendix G

Table 4.8-4 compares the proposed 2021 LRDP annual GHG emissions to the UCR thresholds.

Table 4.8-4 Comparison of Proposed 2021 LRDP Projected GHG Emissions Without Mitigation Against UCR Thresholds

	Emissions per Threshold (MT CO_2e)		
	2021-2025	**2026-2030**	**2030-2035**
Projected Annual Scopes 1, 2, and 3 Emissions Pre-Mitigation	**139,920**	**159,124**	**155,029**
Total 2018 Baseline Emissions[1]	97,232	97,232	97,232
Meeting Threshold?	**No**	**No**	**No**
UC Policy on Sustainable Practices[2] (Carbon Neutral Scope 1 and Scope 2, only Scope 3 Emissions Permitted)	n/a	41,471	41,471[4]
Meeting Threshold?	**n/a**	**No**	**No**
SB 32 Emissions Compliance[3] (40% below 1990 levels [82,167 $MTCO_2e$])	n/a	n/a	49,300[4]
Meeting Threshold?	**n/a**	**n/a**	**No**

Notes:

[1] UCR would utilize the 2018 Baseline Emissions Threshold between 2021 LRDP adoption through December 31, 2025

[2] UCR would achieve carbon neutrality for Scope 1 and Scope 2 emissions per the *UC Policy on Sustainable Practices* beginning on January 1, 2026 ; only Scope 3 emissions would be permitted.

[3] UCR would demonstrate compliance with SB 32 no later than December 31, 2030

[4] Compliance with the *UC Policy on Sustainable Practices* would result in campus-wide emissions reductions greater than the State targets under SB 32.

UCR emissions under the proposed 2021 LRDP are projected to exceed 2018 baseline emissions, *UC Policy on Sustainable Practices*, and SB 32 reduction targets. As such, UCR emissions under the proposed 2021 LRDP would represent a significant and cumulatively considerable contribution to climate change. This impact would be significant. Mitigation Measure **MM GHG-1** (on-campus GHG emissions reduction measures) and **MM GHG-2** (carbon offset purchases) would be required to reduce impacts to less than significant levels. Thus, impacts are considered to be **less than significant with mitigation incorporated**.

Mitigation Measures

MM GHG-1 Implement On-Campus GHG Emissions Reduction Measures

UCR shall implement the following GHG emissions reduction measures by scope emissions category:

SCOPE 1 (STATIONARY FUEL COMBUSTION, REFRIGERANT USE, FLEET FOSSIL FUEL COMBUSTION)

Energy (EN)

- Measure EN1: In order to meet 100 percent electrification of all new campus buildings and structures, UCR shall prioritize construction of all-electric building design for new campus buildings and structures and discourage the construction and connection of new fossil fuel combustion infrastructure on campus. In addition, UCR shall focus on energy optimization through the Central Plant control systems by automating manual processes and initiating an engineering study focused on transitioning away from natural gas use at the Central Plant.
- Measure EN2: In order to address on-campus natural gas combustion, starting in 2025 and continuing through 2035, UCR shall purchase biogas for at least 40 percent of the total on-campus natural gas usage.

Global Warming Potential (GWP)

- Measure GWP1: In order to reduce emissions from refrigerants used on campus, UCR shall phase out of high global warming potential chemical refrigerants on campus to achieve 100 percent relative carbon neutrality by 2045. This may include the replacement of chemical refrigerants with lower global warming potential in the interim of full phase out while an alternative technology is determined. Furthermore, UCR shall prohibit the use of equipment in new buildings or construction projects that do not utilize low global warming potential or Significant New Alternatives Policy Program accepted refrigerants.

Fuel (FL)

- Measure FL1: In order to decarbonize the campus vehicle fleet, UCR shall reduce emissions from the campus vehicle fleet by 25 percent by 2025, by 50 percent by 2030, and by 75 percent by 2035 through replacement of fleet vehicles with electric vehicles or low-emission alternative vehicles.

SCOPE 2 (ELECTRICITY CONSUMPTION AND GENERATION)

Energy (EN)

- Measure EN3: UCR shall work to obtain 100 percent clean-sourced electricity through either Riverside Public Utilities (RPU) and/or through the installation of on-site clean-sourced electricity sources for all new buildings by 2025. In addition, UCR shall establish annual budgets that include funding to purchase 100 percent clean-sourced energy. Furthermore, all newly constructed building projects, other than wet lab research laboratories, shall be designed, constructed, and commissioned to outperform the California Building Code (Title 24 portion of the California Code of Regulations) energy efficiency standards by at least 20 percent. Finally, UCR shall incorporate solar PV as feasibly possible for newly constructed and majorly-renovated buildings with the maximum system size, highest solar panel efficiency, and greatest system performance.[22]
- Measure EN4: In order to obtain electricity from 100 percent renewable source(s) for all existing buildings by 2045, UCR shall renegotiate its contractual agreement with RPU to establish a schedule and specific goals for obtaining 100 percent renewable electricity for the campus. In addition, UCR shall conduct an evaluation of existing buildings for structural suitability in terms of accommodating a solar photovoltaic system capacity with highest energy generation yield and for installing energy storage technology on campus and then installing such systems on identified buildings and facilities.
- Measure EN5 (Parts A, B, C): In order to prioritize energy efficiency and green building initiatives for building/facility upgrades and new construction as well as reduced energy use, UCR shall identify aging equipment throughout the campus such as equipment associated with the Central Plant, electrical distribution system, and building HVAC systems and develop a strategy and schedule to upgrade such equipment with high-energy efficiency systems and optimize HVAC systems through heat zoning, high-efficiency filters, and shut-down times expansion. The strategy shall include an evaluation and cost analysis related to upgrading/retrofitting equipment versus retirement of equipment if no longer needed with future initiatives (i.e., Central Plant boiler retirement). The schedule and upgrade strategy must meet a 2 percent energy efficiency improvement annually through 2035. In addition, UCR shall require new buildings to incorporate occupancy sensors and controls such that lighting of shared spaces is on

[22] The EIR GHG modeling efforts assume that clean energy is in line with California-defined renewable sources.

occupancy sensors, building temperature set points are widened and aligned with occupancy schedules, and ventilation systems are converted from constant volume to variable so ventilation rates are occupancy-based. Furthermore, UCR shall develop a plan to identify existing buildings and projects that could undergo upgrades to the control systems and establish a schedule for upgrade incorporation. Finally, UCR shall develop a tracking program to monitor and share campus energy efficiency activities and progress towards increased energy efficiency.

SCOPE 3 (WASTE GENERATION, BUSINESS AIR TRAVEL, ON-SITE TRANSPORTATION, WATER CONSUMPTION, CARBON SEQUESTRATION, AND CONSTRUCTION)

Waste Generation (WG)

- Measure WG1: UCR shall implement and enforce SB 1383 organics and recycling requirements to specifically reduce landfilled organics waste to 75 percent by 2025.
- Measure WG2: UCR shall reduce campus waste sent to landfills 90 percent by 2025 and 100 percent by 2035. In addition, UCR shall reduce waste generation at campus events 25 percent by 2025 and 50 percent by 2035, with goals of being zero waste and plastic free events. Furthermore, UCR shall establish purchasing and procurement policies and guidelines prioritizing vendors that limit packaging waste and purchase reusable and compostable goods.

Transportation (TR)

- Measure TR1: In order to reduce GHG Emissions related to business air travel, UCR shall provide incentives to faculty for emission-reducing behaviors and utilizing travel options that are less carbon intensive, promote the use of virtual meetings, and encourage alternative forms of travel other than air travel.
- Measure TR2: UCR shall update the Transportation Demand Management (TDM) program for the campus to decrease single occupancy vehicle VMT 5 percent by 2025 and 20 percent by 2035. In addition, UCR shall evaluate trends of current programs to expand on existing programs and establish new initiatives that utilize proven successful strategies.
- Measure TR3: UCR shall develop and implement a Campus Active Transportation Plan to shift 2 percent of baseline (2018) passenger vehicle VMT to active transportation by 2025 and 8 percent by 2035. In addition, UCR shall update the Campus Bicycle and Pedestrian Network Map every five years, including routes from off campus to on campus.
- Measure TR4: UCR shall reduce GHG emissions associated with campus commuting 10 percent by 2025 and 25 percent by 2035.

Water Consumption(WC)

- Measure WC1: UCR shall reduce per-capita water consumption 20 percent by 2025 and 35 percent by 2035 compared to academic year 2018/2019 per capita consumption.

Carbon Sequestration (CS)

- Measure CS1: UCR shall increase carbon sequestration through increasing tree planting and green space 5 percent by 2025 and 15 percent by 2035.

Construction (CR)

- Measure CR1: UCR shall reduce construction-related GHG emissions on campus 10 percent by 2025 and 25 percent by 2035 through emission reduction controls and/or electric equipment requirements in line with contract obligations related to minimizing off-road construction

equipment emissions. Specifically, UCR shall require off-road diesel-powered construction equipment greater than 50 horsepower to meet the Tier 4 emission standards as well as construction equipment to be outfitted with BACT devices certified by CARB and emissions control devices that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similar-sized engine. In addition, UCR shall develop zero waste procurement guidelines and processes for campus construction projects and integrate into purchasing RFP language as part of campus procurement.

The UCR Office of Sustainability, Facilities Services, Environmental Health & Safety (EH&S), Transportation and Parking Services (TAPS), and/or Planning, Design & Construction (PD&C) shall annually monitor, track, and verify implementation of these GHG emissions reduction measures.

MM GHG-2 Purchase Carbon Offsets to Achieve GHG Emissions Reduction Balance

In order to achieve the necessary GHG emissions reduction balance after implementation of Mitigation Measure MM GHG-1 and in order to meet the *UC Policy on Sustainable Practices* and State targets, UCR shall annually track and purchase carbon offsets for the balance of GHG emissions after on-site reductions per Mitigation Measure MM GHG-1 that still meet or exceed the UCR emissions targets by year.

UCR shall sequester funds for carbon offset purchases into a restricted account such that any/all uses shall directly reduce carbon emissions and address UCR goals. Prior to the purchase of carbon offsets, UCR shall research and purchase carbon offsets that are real, permanent, quantifiable, verifiable, enforceable, supported by substantial evidence, and additional to any GHG emission reduction otherwise required by law or regulation and any other GHG emission reduction that otherwise would occur under Mitigation Measure **MM GHG-1**.

If any changes occur with regard to implementation of on-campus GHG reduction measures as part of Mitigation Measure **MM GHG-1**, UCR shall adjust the purchase of carbon offsets accordingly and keep respective accounting records. UCR Office of Sustainability, Facilities Services, EH&S, and PD&C shall annually monitor, track, and verify purchase of the required carbon offsets.

As part of this mitigation measure, UCR shall make the following separate, though overlapping, GHG emission reduction commitment including maintaining compliance with carbon offset accreditation requirements under the CARB Cap-and-Trade Program. Any carbon credits obtained for the purpose of compliance with the CARB Cap-and-Trade Program shall be purchased from an accredited carbon credit market. Based on the current program as of 2021, such offset credits (or California Carbon Offsets) shall be registered with, and retired by an Offset Project Registry, as defined in 17 California Code of Regulations Section 95802(a), that is approved by CARB, such as, but not limited to, Climate Action Reserve (CAR), American Carbon Registry, and Verra (formerly Verified Carbon Standard), that is recognized by The Climate Registry, a non-profit organization governed by U.S. states and Canadian provinces and territories.

Significance After Mitigation

Table 4.8-5 shows the GHG emissions reduction measures quantification summaries by scope and year associated with implementation of the various GHG reduction measures identified under Mitigation Measure **MM GHG-1**. Where GHG reduction measures were considered supportive and, thus, not quantifiable, specific quantification cannot be determined.

Table 4.8-5 Scopes 1, 2, and 3 GHG Emissions On-campus Reduction Measures Quantification Summary

	Project Reduction Value per Measure by Year		
Emissions Reduction Measures	**2025**	**2030**	**2035**
Scope 1 Emissions Reduction Measures			
Measure EN1: Require 100 percent electrification of all new Campus buildings and structures.		Supportive	
Measure EN2: Addressing On-campus natural gas combustion.	12,341	15,651	19,072
Measure EN3: Obtain electricity from 100 percent clean energy source(s) for all new buildings.	487	974	1,460
Measure EN5 Part A: Prioritize energy efficiency and green building initiatives for building/facility upgrades and new construction.	1,083	2,747	4,252
Measure EN5 Part B: Prioritize initiatives that promote behaviors that reduce energy use and establish operational strategies to implement that will increase energy efficiency.	103	206	310
Measure GWP1: Reduce emissions from refrigerants used on Campus by 100 percent by 2045.	176	349	587
Measure FL1: Decarbonize Campus vehicle fleet 100 percent by 2045.	271	663	1,218
Total Scope 1 Emissions Reduction	**14,461**	**20,590**	**26,899**
Scope 2 Emissions Reduction Measures			
Measure EN3: Obtain electricity from 100 percent clean energy source(s) for all new buildings.	5,569	8,837	8,837
Measure EN4: Obtain electricity from 100 percent renewable source(s) for all existing buildings by 2045.		Supportive	
Measure EN5 Part A: Prioritize energy efficiency and green building initiatives for building/facility upgrades and new construction.	2,905	5,849	6,035
Measure EN5 Part B: Prioritize initiatives that promote behaviors that reduce energy use and establish operational strategies to implement that will increase energy efficiency.	59	94	94
Measure EN5 Part C: Develop a tracking program to monitor and share Campus energy efficiency activities and progress towards increased energy efficiency.		Supportive	
Total Scope 2 Emissions Reduction	**8,533**	**14,780**	**14,966**

Emissions Reduction Measures	Project Reduction Value per Measure by Year		
	2025	2030	2035
Scope 3 Emissions Reduction Measures			
Measure WG1: Implement and enforce SB 1383 organics and recycling requirements to reduce landfilled organics waste emissions 50 percent by 2022 and 75 percent by 2025.	191	222	252
Measure WG2: Reduce Campus waste sent to landfills 90 percent by 2025 and 100 percent by 2035.	15	9	110
Measure TR1: Reduce GHG Emissions Related to Business Air Travel.		Supportive	
Measure TR2: Implement programs for shared transit that decrease passenger vehicle VMT 5 percent by 2025 and 20 percent by 2035.	1,484	1,516	5,885
Measure TR3: Develop and implement a Campus Active Transportation Plan to shift 2 percent of baseline (2018) passenger vehicle VMT to active transportation by 2025 and 8 percent by 2035.	104	106	412
Measure TR4: Reduce GHG emissions associated with Campus commuting 10 percent by 2025 and 25 percent by 2035. This supports UC Sustainability Practices Policy D.2.	1,380	1,410	1,060
Measure WC1: Reduce per-capita water consumption 20 percent by 2025 and 35 percent by 2035 compared to academic year 2018/2019 per capita consumption. This supports and expands upon UC Policy on Sustainable Practices I1.		Not Quantified[1]	
Measure CS1: Increase carbon sequestration through increasing tree planting and green space 5 percent by 2025 and 15 percent by 2035.	11	11	32
Measure CR1: Reduce construction-related GHG emissions on Campus 10 percent by 2025 and 25 percent by 2035 through emission reduction controls and/or electric equipment requirements.	292	110	275
Total Scope 3 Emissions Reduction	**3,477**	**3,384**	**8,026**
Projected Total Scopes 1, 2, and 3 Emissions Reductions	**26,471**	**38,754**	**49,891**

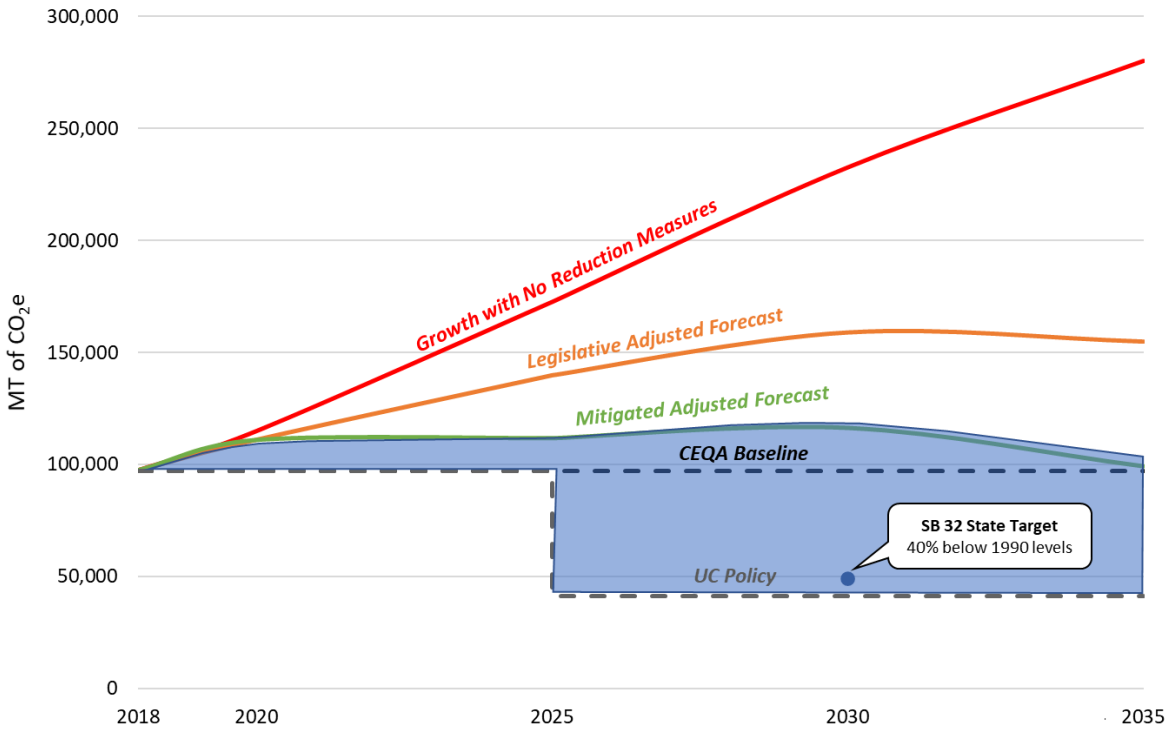
Notes: Total numbers are rounded values.

[1] Emissions related to water and wastewater were not included in the UCR 1990 and 2018 GHG inventories, and, as a result, data for this sector was not quantified for future conditions.

Source: Calculated and compiled by Rincon Consultants, Inc. See Appendix G.

Figure 4.8-5 visually demonstrates the calculated reduction value of Mitigation Measure MM GHG-1 as represented by the green line label "Mitigated Adjusted Forecast." The blue shaded area represents the anticipated value of the purchase of carbon offsets with the implementation of Mitigation Measure MM GHG-2. The dash lines represent the CEQA baseline threshold (black dash) and the UC Policy threshold (grey dash), while the dark blue dot represents the SB 32 2030 state target.

Figure 4.8-5 UCR Forecasted Growth Comparison to Thresholds



Similar to actual, annual emissions fluctuations year-over-year (dependent on true growth implemented under the proposed 2021 LRDP), emissions reduction measures may be implemented in increments (i.e., one or more over time) and to differing degrees (i.e., more of one measure, less of one measure). By annually tracking GHG emissions levels, UCR would be able to calculate and purchase carbon offsets for the balance of GHG emissions after on-site reductions per Mitigation Measure MM GHG-1 that still exceed the UCR emissions thresholds by year, to meet the UCR GHG emissions targets of:

- 2018 baseline GHG emissions levels of 97,232 $MTCO_2e$ between 2021 LRDP adoption through December 31, 2025;
- *UC Policy on Sustainable Practices* emissions restrictions beginning on January 1, 2026 (i.e., carbon neutral Scope 1 and Scope 2 emissions); only Scope 3 emissions would be permitted; and
- Compliance with SB 32 no later than December 31, 2030 (40 percent below 1990 levels [82,167 $MTCO_2e$]).

With implementation of Mitigation Measures **MM GHG-1 and MM GHG-2** requiring on-campus GHG reduction measures and the purchase of carbon offsets, the proposed 2021 LRDP would result in mitigated emissions that meet the UCR Thresholds. Therefore, with implementation of the identified mitigation measures, impacts related to generation of GHG emissions under the proposed 2021 LRDP would be **less than significant with mitigation incorporated**.

Impact GHG-2 CONFLICT WITH AN APPLICABLE PLAN, POLICY OR REGULATION ADOPTED FOR THE PURPOSE OF REDUCING THE EMISSIONS OF GREENHOUSE GASES.

THE PROPOSED 2021 LRDP GHG EMISSIONS DURING CONSTRUCTION AND OPERATION ARE PROJECTED TO EXCEED THE STATE TARGETS AND UC-DERIVED GHG EMISSION THRESHOLDS. THEREFORE, THE PROPOSED 2021 LRDP WOULD CONFLICT WITH THE GOALS OF AN APPLICABLE PLAN, POLICY OR REGULATION ADOPTED FOR THE PURPOSE OF REDUCING THE EMISSIONS OF GREENHOUSE GASES. HOWEVER, THIS IMPACT WOULD BE LESS THAN SIGNIFICANT WITH THE IMPLEMENTATION OF MITIGATION MEASURES.

Campus development under the proposed 2021 LRDP would result in additional GHG emissions due to construction, an increase in mobile sources, more building space requiring more heating and cooling, and an increased campus population with respective operational activities entailing both increased commute-related mobile emissions and building energy-related stationary emissions. However, with implementation of the proposed 2021 LRDP:

- Existing campus facilities slated for retrofit would be redeveloped to be more energy efficient, resulting in less energy use and generating less emissions for those same facilities than under existing conditions (per **MM GHG-1**);
- New and retrofitted on-campus facilities would be developed to meet or exceed energy efficiency standards with a commitment to meet 2019 CBC Title 24 Part 6 (Building Energy Efficiency Standards) and Part 11 (California Green Building Standard) as well as achieve at least LEED Silver building certification, thereby resulting in fewer GHG emissions related to electricity and natural gas use compared to existing on-campus facilities (per **MM GHG-1**);
- Land use and planned infrastructure would be developed to discourage personal non-renewable fuel vehicle use, such as through construction of bicycle and transit infrastructure and encouragement of use of EVs, thereby reducing transportation-related emissions (per **MM GHG-1**) ; and
- Remaining GHG emissions that need to be reduced after the physical implementation of the proposed 2021 LRDP to meet UCR's GHG reduction targets would be abated by purchases of renewable energy credits and verified by carbon offset credits by UCR (**MM GHG-2**).

The proposed 2021 LRDP was evaluated for consistency with applicable State and UC plans that were developed with the intent of reducing GHG emissions. Applicable State and UC plans are discussed separately below.

Consistency with State Plans

The CARB 2017 Scoping Plan outlines a pathway to achieving the GHG emissions reduction targets set under SB 32 that are considered interim targets toward meeting the longer-term 2045 carbon neutrality goal established by EO B-55-18. Implementation of the proposed 2021 LRDP would impede "substantial progress" toward meeting the SB 32 and EO B-55-18 targets if the proposed 2021 LRDP GHG emissions exceeded the respective State targets derived as 2025, 2030, and 2035 GHG emission thresholds. As discussed under Impact GHG-1, the proposed 2021 LRDP's GHG emissions would exceed these State targets. As a result, implementation of the proposed 2021 LRDP would conflict with the reduction targets of the 2017 Scoping Plan and SB 32, and, therefore, EO B-55-18, and would contribute to climate change. This impact is **significant**. Mitigation Measures **MM GHG-1 and MM GHG-2** requiring on-campus GHG reduction measures and the purchase of carbon offsets would be required.

With implementation of Mitigation Measures **MM GHG-1 and MM GHG-2**, UCR Scopes 1, 2, and 3 emissions would be reduced to meet State targets by 2025, 2030, and 2035 respectively and demonstrate UCR's path toward achieving the emissions goals outlined by these State plans. As such, the proposed 2021 LRDP would not preclude or create obstacles to future attainment of the related State GHG reduction goals. Therefore, the proposed 2021 LRDP impacts related to consistency with applicable State plans for GHG reduction would be **less than significant with mitigation incorporated**.

Consistency with UC Sustainability Policy

The UC Sustainability Policy commits UC campuses, including UCR, to achieve carbon neutrality in terms of Scopes 1 and 2 emissions by 2025 and carbon neutrality in terms of all scopes by 2050 or sooner. The plan-specific GHG emissions thresholds utilized for the proposed 2021 LRDP in this analysis are interpolated targets for 2025, 2030, and 2035 to comply with a net-zero Scopes 1 and 2 emissions date of 2025.

As shown in Table 4.8-3, the proposed 2021 LRDP Scopes 1 and 2 emissions in 2025 are projected to total 98,448 $MTCO_2e$ per year. Therefore, when evaluated under the *UC Policy on Sustainable Practices* target, the 2021 LRDP would not be consistent with the *UC Policy on Sustainable Practices* of Scopes 1 and 2 climate neutrality (i.e., net zero emissions) by 2025 and would represent a an obstacle to future attainment of the related UCR GHG reduction goal related to Scopes 1 and 2 emissions. This impact is significant. Mitigation Measures **MM GHG-1 and MM GHG-2** requiring on-campus GHG reduction measures and the purchase of carbon offsets would be required.

With implementation of Mitigation Measures **MM GHG-1 and MM GHG-2**, UCR Scopes 1 and 2 emissions would demonstrate carbon neutrality by 2025 as well as UCR's path toward achieving the emissions goals outlined by the *UC Policy on Sustainable Practices*. As such, the proposed 2021 LRDP would not preclude or create obstacles to future attainment of the related UC GHG reduction goals. Therefore, the proposed 2021 LRDP impacts related to consistency with applicable UC plans for GHG reduction would be **less than significant with mitigation incorporated**.

Mitigation Measures

See Mitigation Measures **MM GHG-1 (Implement On-Campus GHG Emissions Reduction Measures) and MM GHG-2 (Purchase Carbon Offsets to Achieve GHG Emissions Reduction Balance)** under Impact GHG-1.

Significance After Mitigation

See *Significance After Mitigation* discussion under Impact GHG-1. With implementation of **MM GHG-1 and MM GHG-2** requiring on-campus GHG reduction measures and the purchase of carbon offsets, the proposed 2021 LRDP would result in GHG emissions that meet the 2025, 2030, and 2035 GHG emission State and UC-derived targets. The proposed 2021 LRDP would not impede "substantial progress" toward meeting the CARB 2017 Scoping Plan, SB 32, EO B-55-18, or *UC Policy on Sustainable Practices* targets. Therefore, with implementation of the identified mitigation measures, impacts related to the proposed 2021 LRDP consistency with applicable GHG reduction plans would be **less than significant with mitigation incorporated**.

4.8.4 Cumulative Impacts

GHG emissions and global climate change represent cumulative impacts. GHG emissions cumulatively contribute to the significant adverse environmental impacts of global climate change. No single project could generate enough GHG emissions to noticeably change the global average temperature; instead, the GHG emissions from past, present, and future projects and activities have contributed, currently are contributing, and would contribute to global climate change and its associated environmental impacts.

Project GHG emissions are inherently cumulative and do not require the estimation of cumulative projects in the region of a project (i.e., cumulative projects listed in Table 4-1). Rather, the determination of GHG cumulative impacts is based on the proposed plan's compliance with State targets established by SB 32 and EO B-55-18 to reduce GHG emissions to 40 percent below 1990 levels by 2030 and to net zero by 2045. In order to ensure that this goal would be achieved, Air Districts and Lead Agencies develop GHG thresholds to ensure compliance with the State target. Projects with GHG emissions in conformance with these thresholds, therefore, would not be considered significant for purposes of CEQA. In addition, although the emissions from such cumulative projects would add an incremental amount to the overall GHG emissions that cause global climate change impacts, emissions from projects consistent with these thresholds would not be a "cumulatively considerable" contribution under CEQA. Such projects would not be "cumulatively considerable," because they would be helping to solve the cumulative problem as a part of the SB 32 Scoping Plan process. As determined under Impact GHG-1, the proposed plan would exceed the applicable State target derived thresholds. Furthermore, as discussed under Impact GHG-2, the proposed 2021 LRDP would conflict with applicable plans adopted to reduce the emissions of GHGs, specifically the *UC Policy on Sustainable Practices*, CARB 2017 Scoping Plan, SB 32, and EO B-55-18. Therefore, there would be a potentially **significant cumulative impact** related to GHG emissions.

However, implementation of Mitigation Measures **MM GHG-1 and MM GHG-2** would reduce impacts related to the proposed 2021 LRDP's generation of GHG emissions to a less-than-significant level (represented by more than 40 percent below 1990 levels by 2030). And implementation of Mitigation Measures **MM GHG-1 and MM GHG-2** would reduce impacts related to the proposed 2021 LRDP's consistency with applicable GHG reduction plans to a less-than-significant level (represented by consistency with the *UC Policy on Sustainable Practices*, CARB 2017 Scoping Plan, SB 32, and EO B-55-18). As such, there would be a **less than significant with mitigation incorporated cumulative impact** related to GHG emissions generation and consistency with applicable GHG reduction plans.

4.8.5 References

California, State of. 2018a. California's Fourth Climate Change Assessment Statewide Summary Report. Available: <http://www.climateassessment.ca.gov/state/>.

_____. 2018b. California's Fourth Climate Change Assessment Los Angeles Region Report. <http://www.climateassessment.ca.gov/regions/docs/20180928-LosAngeles.pdf>.

CARB. 2018. EMFAC2017 Volume III – Technical Documentation. <https://www.arb.ca.gov/emfac/>.

_____. 2020. California GHG Emissions for 2000 to 2018: Trends of Emissions and Other Indicators. <https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2018/ghg_inventory_trends_00-18.pdf>.

_____. 2021. CARB Waiver Timeline. <https://ww2.arb.ca.gov/resources/documents/carb-waiver-timeline>.

Intergovernmental Panel on Climate Change (IPCC). 2007a. AR4 Climate Change 2007: The Physical Science Basis. <https://www.ipcc.ch/report/ar4/wg1/>.

_____. 2007b. AR4 Climate Change 2007: Synthesis Report. <https://www.ipcc.ch/report/ar4/syr/>.

_____. 2014a. Frequently Asked Questions. <https://www.ipcc-nggip.iges.or.jp/faq/FAQ.pdf>.

_____. 2014b. Summary for Policymakers. In: AR5 Climate Change 2014, Mitigation of Climate Change. <https://www.ipcc.ch/report/ar5/wg3/>.

_____. 2018. Summary for Policymakers. In: Global warming of 1.5°C. An IPCC Special Report. . https://www.ipcc.ch/sr15/>.

NASA. 2010. Global Warming. https://earthobservatory.nasa.gov/features/GlobalWarming/page2.php.

Riverside Transit Agency (RTA). 2019. Short Range Transit Plan FY19-FY21. <https://www.riversidetransit.com/images/DOWNLOADS/PUBLICATIONS/SRTPS/FY2019-2021 percent20SRTP.pdf>.

Seinfeld, J.H. and S.N. Pandis. 2006. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2nd Edition. New York. John Wiley & Sons.

Southern California Gas (SCG). 2016. Gas Transmission Pipeline Interactive Map- Riverside. https://socalgas.maps.arcgis.com/apps/webappviewer/index.html?id=aaebac8286ea4e4b8e425e47771b8138.

The Climate Registry (TCR). 2020. Default Emission Factors. <https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf>.

USDOT. 2021. USDOT National Highway Traffic Safety Administration CAFE Preemption Notice of Proposed Rulemaking. https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/cafe_preemption_nprm_04222021_1.pdf.

United States Environmental Protection Agency (US EPA). 2018. Emission Factors for Greenhouse Gas Inventories. <https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf>.

_____. 2020. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018. <https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf>.

U.S. White House. 2021. Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/>.

United Nations Environmental Program/GRID-Arendal. 2005. Greenhouse Effect. <https://www.grida.no/resources/6467>.

University of California (UC). 2020. UC Policy on Sustainable Practices. <https://policy.ucop.edu/doc/3100155/SustainablePractices>.

University of California, Riverside (UCR). 2005. 2005 Long Range Development Plan Final Environmental Impact Report: Volume I, Draft EIR.

_____.2021. CE-CERT Energy Efficiency Improvements for Building HVAC System. https://www.cert.ucr.edu/sites/g/files/rcwecm1251/files/2020-03/SIGI%20Posters%202.pdf.