Appendix G

GHG Emissions Supporting Information

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Appendix G1

Final GHG Inventory, Forecast, and Targets Methodology and Calculations Report

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Final GHG Inventory, Forecast, and Targets Methodology and Calculations Report

University of California, Riverside
2021 Long Range Development Plan

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1 Introduction

California considers greenhouse gas (GHG) emissions and the impacts of climate change to be a serious threat to the public health, environment, economic well-being, and natural resources of the State and has taken an aggressive stance to address the impact of climate change at the State-level through the adoption of legislation and policies. Many institutions in California have developed campus climate action plans or GHG reduction strategies and aligned goals to correspond with State emissions reduction targets. The University of California, Riverside (UCR) has tracked GHG emissions for its main campus and associated satellite facilities (as stipulated by the UC Sustainable Practices Policy) since 2009. In addition, the University of California (UC) has established policy goals to achieve carbon neutrality for Scope 1 and Scope 2 emissions by 2025 and carbon neutrality for Scope 3 emissions by 2050 or sooner.[1]

The two major State GHG emissions-related goals are established by Assembly Bill (AB) 32 and Senate Bill (SB) 32. AB 32 required State agencies to reduce State GHG emissions to 1990 levels by 2020, whereas SB 32 requires a 40 percent reduction below 1990 levels by 2030. The goals set by AB 32 were achieved even earlier by the State in 2016,[2] and many California institutions are completing updated GHG inventories to quantify progress toward their specific 2020 goals as well as develop targets to align with the requirements of SB 32. Recently, Executive Order (EO) B-55-18, was passed in 2018 by Governor Jerry Brown and set a goal for achieving carbon neutrality Statewide by 2045. These EOs are applicable to State Agencies such as the UC.

UCR has prepared this GHG inventory as a primary step in its GHG reduction strategy (GHGRS). The GHGRS is being developed in conjunction with the 2021 Long Range Development Plan (LRDP) to ensure that the 2021 LRDP is implemented in alignment with the UC Sustainable Practices Policy and to fulfill the GHG emissions reduction requirements of SB 32 and the requirements of California Environmental Quality Act (CEQA) Guidelines Section 15183.5. CEQA Guidelines Section 15183.5 specifically addresses how a lead agency, in this case UCR, can analyze and mitigate GHG emissions at a programmatic level.

This report details the methodology and results of the GHG emissions inventory completed for UCR, and the forecast of future GHG emissions, and the GHG target setting for the 2021 LRDP. The emissions inventory was completed for the 2018 calendar year and provides a basis for the associated GHG emissions forecast. GHG emissions are forecasted for the years 2025, 2030, and 2035 to align with UC Sustainability Practices Policy emissions target year (2025), State SB 32 emissions target year (2030) and the 2021 LRDP planning horizon year (2035). GHG emissions are also forecasted for the year 2045 (to align with EO B-55-18) for informational purposes; this allows for determining a trajectory post-2035, which is necessary for 2035 target setting. GHG emissions are forecasted under baseline, business-as-usual,[3] and adjusted scenarios. The adjusted forecast scenario accounts for the impact of State regulations on GHG emissions. Results of the forecasts in turn inform GHG reduction target setting.

[1] This report refers to emissions scopes per the California Air Resources Board (CARB) 2017 Climate Change Scoping Plan. Refer to Section 1.2, *Geographic and Operational Boundaries*, for additional information about what the various emissions scopes entail.

[2] CARB. California Greenhouse Gas Emissions Inventory. Available: <https://ww3.arb.ca.gov/cc/inventory/inventory.htm>. Accessed July 8, 2020.

[3] The business-as-usual forecast scenario provides a projection of GHG emissions would change in the forecast years if consumption trends continue as in 2018, absent any new regulations which would reduce emissions.

1.1 Regulatory Background

State GHG Emissions Targets

The State of California considers GHG emissions and the impacts of global warming to be a serious threat to the public health, environment, economic well-being, and natural resources of California, and has taken an aggressive stance to mitigate the State's impact on climate change through the adoption of legislation and plans. The following legislative and plan targets inform the State targets.

- **Executive Order S-3-05 (2005),** signed by former Governor Schwarzenegger in 2005, establishes Statewide GHG emissions reduction goals to achieve longer-term climate stabilization as follows: by 2020, reduce GHG emissions to 1990 levels and by 2050, reduce GHG emissions to 80 percent below 1990 levels. The 2050 goal was accelerated by the 2045 carbon neutral goal established by EO B-55-18, as discussed below.[4]
- **Assembly Bill 32 (2006),** known as the Global Warming Solutions Act of 2006, requires State GHG emissions be reduced to 1990 levels by the year 2020 (approximately a 15 percent reduction from 2005 to 2008 levels). The AB 32 Climate Change Scoping Plan, first published in 2008, identifies mandatory and voluntary measures to achieve the Statewide 2020 emissions limit, and encourages local governments to reduce municipal and community GHG emissions proportionate with State goals.[5]
- **Climate Change Scoping Plan (2008),** the original California Climate Change Scoping Plan, includes measures to address GHG emission reduction strategies related to energy efficiency, water use, and recycling and solid waste. 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 and implemented since approval of the Scoping Plan.
- **Climate Change Scoping Plan Update (2013),** the first update to the California Climate Change Scoping Plan, defines CARB climate change priorities for the next five years and set the groundwork to reach post-2020 Statewide GHG emissions reduction goals. The 2013 Scoping Plan Update highlighted California's progress toward meeting the 2020 GHG emission 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.
- **Executive Order B-30-15 (2015)**, Establishes Statewide GHG emissions reduction goals of reducing GHG emissions to 40 percent below 1990 levels by 2030.
- **Senate Bill 32 (2016),** signed by former Governor Brown in 2016, codified the Statewide mid-term GHG reduction goal of 40 percent below 1990 levels by 2030.
- **Climate Change Scoping Plan Update (2017)**, CARB approved a 2017 update to the California Climate Change Scoping Plan that lays out a roadmap to achieve 2030 GHG reduction targets.
- **Executive Order B-55-18 (2018),** signed by former Governor Brown in 2018, expanded upon EO S-3-05 by creating a Statewide GHG goal of carbon neutrality by 2045. EO S-55-18 identifies

[4] A state executive order is a directive issued by a governor that regulates operations of the respective state government. California Executive Orders are binding unto California State agencies. Accordingly, EOs S-03-05, B-30-15, and B-55-18 direct UC efforts to control and regulate GHG emissions.

[5] Specifically, the AB 32 Climate Change Scoping Plan States CARB, "encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State commitment to reduce GHG emissions by approximately 15 percent from current levels by 2020" (p. 27). "Current" as it pertains to the AB 32 Climate Change Scoping Plan is commonly understood as between 2005 and 2008.

CARB as the lead agency to develop a framework for implementation and progress tracking toward this goal in the next update to the Climate Change Scoping Plan.

The State of California, via CARB, has issued several guidance documents concerning the establishment of GHG emissions reduction targets for GHG reduction plans to comply with legislated emissions reductions goals. In the first California *Climate Change Scoping Plan,*[6] CARB encouraged local governments to adopt a reduction target for community emissions paralleling the State commitment to reduce GHG emissions. In 2016, the State adopted SB 32 mandating a reduction of GHG emissions by 40 percent from 1990 levels by 2030 and in 2017 CARB published *California's 2017 Climate Change Scoping Plan* (hereafter referred to as the Scoping Plan Update) outlining the strategies the State will employ to reach these targets.[7] With the release of the Scoping Plan Update, CARB recognized the need to balance population growth with emissions reductions and in doing so, provided a new methodology for proving consistency with State GHG reduction goals through the use of per service population efficiency targets.[7] These targets are generated by dividing a institution's GHG emissions for each horizon year by the institution's total population for that target year.

UC GHG Emissions Targets and Existing Reduction Policies

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* (UC Policy), which is updated periodically. In the 2007 revision of the UC Policy, 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. Today, UC's official commitment to sustainability across the above-listed sectors is integrated into the UC Policy updated in July 2020.[8] The UC Policy states that each campus and the UC Office of the President 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 (2020):

- 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. 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

[6] CARB. 2008. Climate Change Scoping Plan. Available: <https://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf>. Accessed July 8, 2020

[7] CARB. 2017. California 2017 Climate Change Scoping Plan. Available: <https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf>. Accessed July 8, 2020

[8] UC. Sustainable Practices Policy. 2020. Available: <https://policy.ucop.edu/doc/3100155/SustainablePractices>. Accessed August 14, 2020.

whole-building energy performance targets listed in Table 1 of Section V.A.3 of the UC Policy, 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.
- 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% replacement of mechanical, electrical, and plumbing systems and replacement of over 50% 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%. 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% annually.
- Policy B.2: 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 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.[9]
- 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%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% relative to its 2015 SOV commute rates;

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

  - By 2050, each location shall strive to have no more 40% of its employees and no more than 30% 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% of commuter vehicles be ZEV.[10]
  - By 2050, each location shall strive to have at least 30% 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. 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. Minimum compliance for zero waste, at all locations other than health locations, is as follows:
  a. Reduce per capita total municipal solid waste generation by:
     i. 25% per capita from FY2015/16 levels by 2025
     ii. 50% per capita from FY2015/16 levels by 2030.
  b. Divert 90% 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 greenhouse gas emissions.

[10] ZEV stands for a zero-emissions vehicle.

[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.

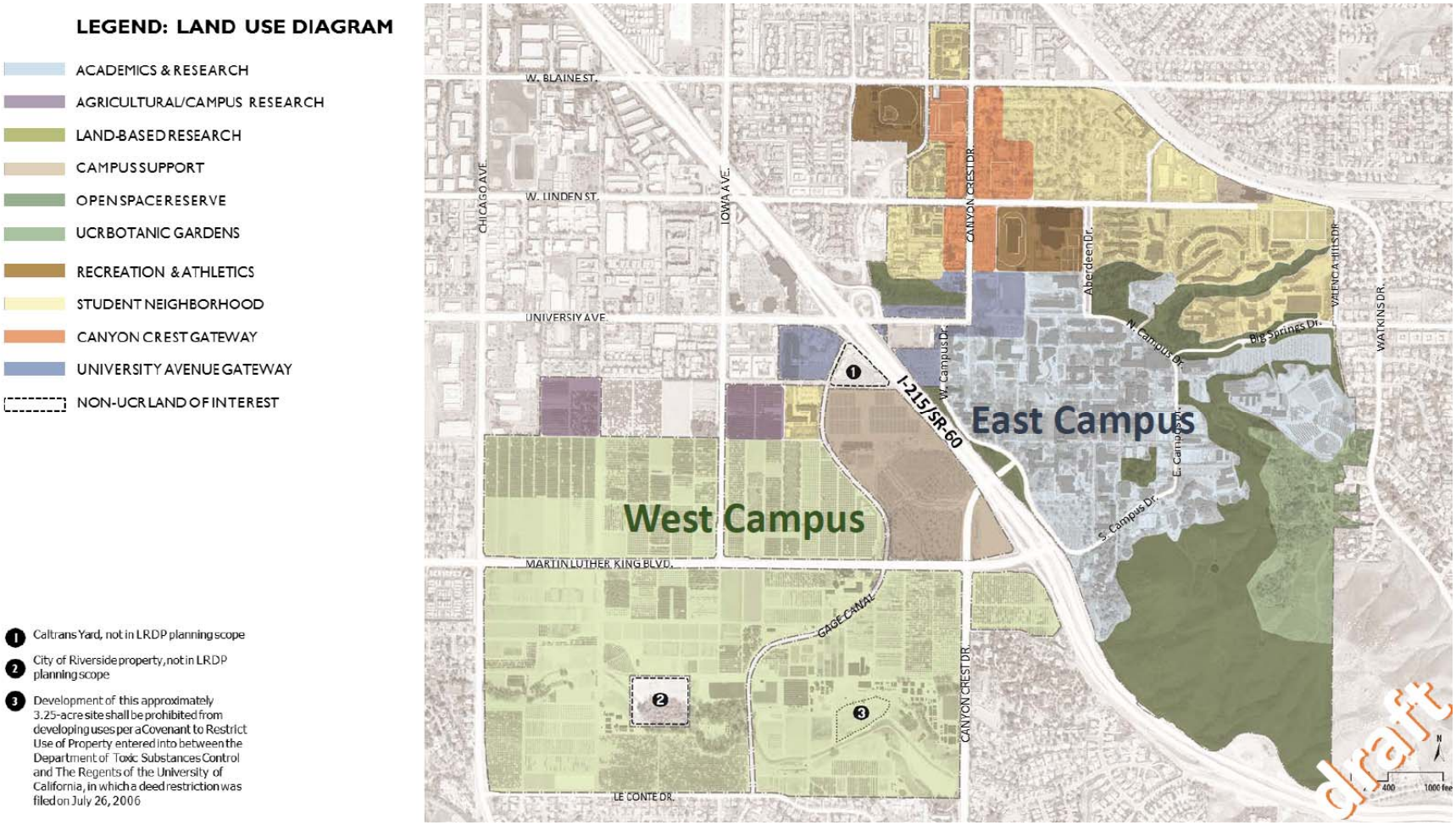
1.2 Geographic and Operational Boundaries

Consistent with standardized GHG reporting protocols, such as those prepared by ICLEI – Local Governments for Sustainability (ICLEI; formerly known as International Council for Local Environmental Initiatives), The Climate Registry (TCR), and American College and University Presidents' Climate Commitment (ACUPCC), a clear delineation of the geographic and operational boundaries used to account for emissions in an inventory must be established. Therefore, the boundaries for the GHG inventory and forecasting included in this report are limited to the geographic and operational boundary of the 2021 LRDP. Similar to the 2005 LRDP, the 2021 LRDP encompasses the approximate 1,108 contiguous acres constituting the UCR main campus, which is bisected by Interstate 215/State Route 60 into two distinct areas commonly referred to as East Campus and West Campus.

Figure 1 depicts the UCR main campus (i.e., the designated 2021 LRDP area) obtained from the 2021 LRDP. The GHG inventory and forecasting included in this report includes emissions from all facilities and sources within these boundaries over which UCR has operational control over. Specifically, for UCR, the following emissions sources are included:

- Scope 1 Emissions: Direct emissions, including stationary combustion such as boilers, hydrofluorocarbon (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.
- 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.

Figure 1 LRDP Operational Boundary



2 2018 GHG Emissions Inventory

This section describes the methodologies, data sources, calculations, and results associated with the UCR 2018 GHG emissions inventory. The 2018 inventory is considered the baseline inventory for the GHG emissions forecasting process to support the UCR 2021 LRDP. The 2018 UCR GHG emissions inventory serves as the inventory to inform development of future GHG emissions forecasts that will assist UCR in setting GHG emissions targets that are consistent with State and UC goals.

2.1 Inventory Data and Methodology

Previous Inventories

The UC Policy requires each UC campus to report a GHG emissions inventory to an independent reporting organization in accordance with American College & University Presidents' Climate Commitment (*ACUPCC*) and The Climate Registry (TCR) requirements. Since 2009, UCR has reported Scope 1 and Scope 2 emissions to TCR using the most current published TCR protocol on an annual basis. UCR also reports Scope 3 emissions, including emissions from business air travel and from commuting by students, faculty, and staff, on an annual basis to the ACUPCC.[12] UCR tracks and reports its progress towards meeting its GHG emissions goals in its Annual Sustainability Report.[13] Historically, emissions reporting data has covered all UCR facilities over which UCR has operational control, including the UCR main campus as defined in the 2021 LRDP, as well as UCR satellite facilities.

1990 GHG Emissions

The State GHG targets are all referenced to Statewide GHG emissions in 1990. Therefore, estimating 1990 GHG emission levels is helpful when establishing GHG baselines and comparing future emissions. However, most agencies do not have completed 1990 GHG inventories or access to high quality data to estimate their 1990 GHG emissions. Based on CARB estimates of Statewide 1990 levels, GHG emissions have grown approximately one percent per year from 1990 to "current" emission levels as defined by the AB 32 Scoping Plan. "Current" as it pertains to the AB 32 Scoping Plan is commonly understood as sometime between 2005 and 2008, the time frame in which the AB 32 Scoping Plan was first adopted (i.e., 2008). As such, it was been deemed appropriate for local agencies to estimate or back-cast to 1990 levels from an inventory within the 2005-2008 timeframe by assuming emissions have grown by 1 percent from 1990 levels to the "current" day levels, defined as between 2005 and 2008 in first Scoping Plan.

UCR utilized historical metered data and back casting to estimate GHG emissions in 1990.[14] Methodology utilized for back casting is detailed in the UCR Climate Action Plan drafted in 2010.[15] UCR calculated Scope 1, 2, and 3 GHG emissions for UCR in 1990 to total 82,167 MT CO_2e. Scope 1 emissions contributed approximately 22 percent (17,535 MT CO_2e), Scope 2 emissions (e.g.,

[12] Association for the Advancement of Sustainability in Higher Education (AASHE). 2016. UCR Sustainability Tracking, Assessment & Rating System (STARS) 2016 Report. Available: <https://reports.aashe.org/institutions/university-of-california-riverside-ca/report/2016-04-21/OP/air-climate/OP-1/>. Accessed July 14,2020.

[13] UCOP. 2019. *Annual Sustainability Report*, Fiscal Year 2018/2019. Available: <https://ucop.edu/sustainability/sustainability_report_2019_f2.pdf>. Accessed June 3, 2020.

[14] UCR. [Drafted] 2010. University of Riverside Climate Action Plan.

[15] Note that this CAP was not formally adopted and provided to Rincon August 20, 2020 to provide details regarding previous inventory and forecast calculations.

electricity) contributed approximately 48 percent (39,704 MT CO_2e), and Scope 3 emissions (e.g., commuting, air travel) contributed approximately 30 percent (24,928 MT CO_2e) to the total UCR GHG emissions.

The 1990 inventory emissions levels calculated using the UCR 2010 Draft CAP methodology have since been utilized by UCR to establish their 2020 emissions target of 82,00 MT CO_2e stipulated by the UC Policy. UCR tracks their progress in achieving 1990 GHG emissions levels by 2020 each year based on data submitted by the UCR Climate Change Working Group (CCWG) and reported on within the Annual Sustainability Report published by the UCOP.

2009 GHG Inventory

The 2009 GHG inventory is the first UCR inventory where Scope 1 and Scope 2 emissions were audited by a third-party verifier. Scope 1 and Scope 2 emissions were reported to TCR, while Scope 3 emissions were reported to ACUPCC. Because this is the earliest year for a UCR GHG inventory to be verified by a third party, UCR reports 2009 as the baseline year under the Sustainability Tracking, Assessment, & Rating System (STARs) report submitted to the Association for the Advancement of Sustainability in Higher Education (AASHE).

The 2009 GHG inventory concluded that Scope 1, 2, and 3 emissions for UCR in 2009 totaled 166,552 MT CO_2e.**Error! Bookmark not defined.,Error! Bookmark not defined.** Scope 3 sources contributed approximately 43 percent (70,877MT CO_2e), Scope 2 emissions contributed approximately 42 percent (70,562MT CO_2e), and Scope 1 emissions contributed approximately 15 percent (25,112MT CO_2e).[16] This increase from estimated 1990 levels is due to campus growth. UCR grew significantly from 1990 to 2009 such that the weighted number of campus users increased from 9,145 to 19,168 between 1990 and 2009.[17]

2012 GHG Inventory

The TCR reporting protocol requires quantification of all Scope 1 and Scope 2 emissions, while reporting of Scope 3 emissions is optional. Although not reported to TCR, UCR tracked Scope 3 emissions from commuting and business air travel for the 2012 inventory. Air travel paid for by UCR was calculated using the Clean Air Cool Campus calculator. Commuting was calculated using a methodology approved by the Southern California Air Quality Management District and UC. Scope 2 emissions were based on the utility-specific emissions factor provided by RPU, rather than the eGRID emissions factor.

The 2012 GHG inventory concluded that Scope 1, 2, and 3 emissions for UCR in 2012 totaled 122,129MT CO_2e. Scope 1 emissions contributed approximately 21 percent (26,047 MT CO_2e), Scope 2 emissions contributed approximately 51 percent (61,671 MT CO_2e), and Scope 3 sources contributed approximately 28 percent (34,412MT CO_2e).[16] This represents a 149 percent increase from estimated 1990 emissions levels and an approximately 27 percent decrease from the 2009 emissions levels.

2018 Inventory (Current) Year

The State of California uses 1990 as a reference year in Assembly Bill (AB) 32, which codified State 2020 GHG emissions target by directing CARB to reduce Statewide emissions to 1990 levels by 2020. However, agencies throughout California typically elect to use years later than 1990 as baseline

[16] Note that values presented in the text are rounded to the nearest whole integer and may not add up to the total.
[17] Weighted campus user is defined per the AASHE STARs Technical Manual and was provided by Institutional Research (July 24, 2019).

years due to the increased reliability of recordkeeping from those years and the large amount of growth that has occurred since 1990. Additionally, the UCR 2005 LRDP projected out to the 2015-2016 academic year. The 2005 LRDP Amendment extended the horizon year out to the 2020-2021 academic year. The calendar year 2018 has been selected as the baseline year for the 2021 LRDP GHG inventory, because it is the most recent year with a complete and accurate data set available that is most representative of the 2021 LRDP organizational and operational boundaries. Data from 2018 has the level of detail necessary to validate the data and disaggregate the data for the 2021 LRDP boundary. Therefore, the 2018 calendar year is the current inventory year for purposes of this report.

GHG Inventory Protocols

Emissions were calculated using standard accounting protocols from the TCR, ACUPCC, and ICELI GHG accounting protocols as described below for each source of emissions. Emissions from nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2) are included in this assessment as well as specific hydrofluorocarbon (HFC) refrigerants used by UCR. Each GHG has a different capability of trapping heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed as carbon dioxide equivalent, or CO_2e. The CO_2e values for these gases are derived from the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change GWP values for consistency with the yearly CARB GHG inventory, as shown in Table 1.[18,19] Each refrigerant also has a unique GWP that is detailed below in Section 2.2, *Scope 1 2018 Inventory Emissions Calculation Results*, based on the refrigerant inventory provided by UCR for 2018.

Table 1 Global Warming Potentials of Greenhouse Gases

Greenhouse Gas	Molecular Formula	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265

MT CO_2e: metric tons of carbon dioxide equivalent

Included Emissions

The 2018 UCR inventory includes estimated emissions for the following categories generated on the UCR main campus in accordance with the boundary of the 2021 LRDP:

- Energy (electricity generation, natural gas use, stationary and mobile fuel combustion)
- Fugitive emissions from high GWP refrigerants
- On-site Transportation (UCR vehicle fleet, on-site transportation, transit vehicles)
- Business Air Travel
- Solid Waste Generation

Emissions from those categories are organized into three scopes (Scopes 1, 2 and 3) depending on the emissions source and level of operational control that UCR has over the emissions. Section 2, *2018 GHG Emissions Inventory,* describes how GHG emissions are categorized into scopes, the

[18] Intergovernmental Panel on Climate Change. 2014. Fifth Assessment Report: Climate Change. Available: <https://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC_SynthesisReport.pdf>. Accessed July 8, 2020.
[19] All calculations use Intergovernmental Panel on Climate Change Fifth Assessment Report GWP values.

specific geographic boundary of the GHG inventory methodologies and protocols used and presents the results of the inventory by scope.

Excluded Emissions

The following emissions categories were excluded from the GHG emissions inventory.

Water Conveyance and Treatment Emissions

GHG emission from the conveyance and treatment of water used on the UCR campus are excluded from the inventory and forecast, because UCR does not operate a wastewater treatment system or have operational control over water pumping. It is not typical under the ACUPCC protocol to include water treatment and conveyance emissions within a campus GHG inventory.[35]

Consumption-based Emissions

GHG emissions from consumption of goods within UCR are excluded from the inventory and forecast of UCR's emissions, as an increase in such goods is considered speculative and uncertain. A widely accepted standard methodology for reporting consumption-based inventory does not currently exist.

Natural and Working Lands Emissions

GHG emissions from carbon sinks and sources in natural and working lands are not included in this inventory and forecast due to the lack of granular data and standardized methodology. Additionally, given the amount of natural lands within the UCR campus, emission impacts are negligible and further would not be impacted by the 2021 LRDP buildout. CARB has included a State-level inventory of natural and working lands in the 2017 Scoping Plan Update[20] GHG inventory; however, at the time of this UCR 2018 inventory, sufficient data and tools were not available to conduct an institution-specific working lands inventory. The Nature Conservancy and California Department of Conservation[21] are exploring options for a tool that may be able to perform these inventories at a more specific geographic level.

About 18 percent of the UCR main campus is designated as open space that includes approximately 154.8 acres of relatively intact natural habitat identified as Open Space Reserve and, approximately 43.7 acres associated with the UCR Botanic Gardens. Additional open space, including the interconnected framework of Primary and Secondary open space that are not defined together as a designated land use are incorporated throughout the campus organization and exist within all of the 2021 LRDP defined land use categories.[22] Additionally, land-based research makes up approximately 38 percent (419.3 acres)[23] of UCR's existing campus land use which predominantly includes agricultural field research. These land uses devoted to open spaces or land-based research for agriculture would more appropriately be characterized as urban green space and farmland,

[20] CARB. California 2017 Climate Change Scoping Plan. Available: <https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf>. Accessed July 8, 2020.

[21] California Department of Conservation. TerraCount Scenario Planning Tool. Available: <https://maps.conservation.ca.gov/terracount/>. Accessed July 8, 2020.

[22] As defined in the 2021 LRDP, Primary Open Spaces include significant campus malls, major pedestrian corridors, streetscapes, quads, and plazas, while Secondary Open Spaces are focused on minor pedestrian linkages that foster greater movement throughout campus, as well as smaller, more intimate, courtyard spaces or plazas. They are not defined together as a designated land use but rather exist as a secondary overlay to land use organization.

[23] UCR. 2011. 2005 LRDP Amendment 2. Available: <http://rplan.ucr.acsitefactory.com/sites/g/files/rcwecm1811/files/2018-10/Final%20-%202005%20LRDP%20Amendment%202.pdf> Accessed July 8, 2020.

respectively, within California's Natural and Working Lands Sector.[24] However, GHG sequestration generated from the open space and natural land uses are excluded from the inventory and forecast due to limited availability of appropriate data.[25]

Agricultural Emissions

CARB considered agricultural sources to include off-road farm equipment, irrigation pumps, crop residue burning, emissions from flooded soils, livestock waste, crop residue decomposition, and fertilizer volatilization. The agricultural activities conducted at UCR do not align with the specified emission sources and will not be affected by the buildout of the 2021 LRDP. Therefore, are not considered a significant contributing source to UCR's GHG emission profile. Furthermore, it is not typical under TCR or ACUPCC protocols to include agriculture and forestry emissions within a campus GHG inventory. Emissions associated with energy use and on-road transportation for maintenance of these areas is included under Scope 1, 2 and 3 emission sources accordingly.

2021 LRDP Building Space and Demographic Data

The 2018 baseline inventory includes a total campus population of 28,661, which includes 23,922 students and 4,739 faculty and staff members.[26] Campus space in 2018 totaled approximately 4,803,500 assignable square feet (asf) or approximately 7,205,250 gross square feet (gsf).[27]

Inventory Structure and Data Types

The 2018 GHG inventory is structured by emission scope, or classifications of GHG emissions based on source. Scope 1 emissions are defined as direct GHG emissions generated from sources within UCR operations that it owns and/or controls. Scope 2 emissions are those generated at power plants when generating electricity that is then consumed at UCR. Scope 3 emissions are other emissions that are generated from the activities of the institution but occur from sources not fully controlled by UCR. Information about the data sources and methodologies used to inventory emissions is presented by scope below.

Scope 1 Emissions

Scope 1 emissions include the stationary combustion of fuels in any stationary equipment to produce electricity, steam, heat or power using equipment in a fixed location; mobile combustion of fuels in fleet transportation sources and emissions from off-road equipment such as those in construction, agriculture, and forestry; process emissions other than fuel combustion from physical or chemical processing; and 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. Under Scope 1, UCR reports all campus emissions from natural gas and diesel stationary combustion at its facilities and buildings, mobile combustion emissions from the UCR mobile fleet, vanpool, and shuttle, as well as usage of refrigerants in HVAC and ventilation systems[28]. UCR does

[24] CalEPA, California Natural Resources Agency, CDFA, CARB, and California Strategic Growth Council. 2019. January 2019 Draft: California 2030 Natural and Working Lands Climate Change Implementation Plan. Available: <https://ww2.arb.ca.gov/sites/default/files/2019-06/draft-nwl-ip-040419.pdf>. Accessed April 24, 2020.

[25] The reduction in GHG emissions from sequestration could be included in the future to the 2018 baseline inventory and forecast after a comprehensive study based on the natural and working land protocol has been completed.

[26] Campus population as Full-time equivalents (FTE) was approximately 23,313.3 in 2018 based on UCOP approximation provided by UCR Campus Planning Department.

[27] Per UCR direction the standard space planning assumption of 1.5 is used to convert assignable square footage (asf) to gross square footage (gsf).

[28] Refrigerants included: R-22, R134A, R-404A, R-407C, R-410A.

not have operational control of any physical or chemical processes other than fuel combustion; therefore, emissions associated with physical or chemical processes are not included in the inventory.

Scope 1 emissions reported by UCR are calculated using natural gas utility data from service providers (stationary combustion), inventoried fuel usage (mobile combustion), and refrigerant usage (fugitive emissions) tracked by various UCR Departments. Rincon completed a review of the calculations and found them to be consistent with the methodologies and principals outlined in the TCR General Reporting Protocol (GRP).[29] Emissions are estimated by collecting activity data such as million British Thermal Unit (MMBtu) of natural gas used in facilities and buildings; gallons of diesel used for portable generators, heaters, etc.; gallons of fuel used by the UCR vehicle fleet, and pounds (lbs) of refrigerants used in facilities and buildings. UCR disaggregated source data in order to provide activity data for solely the main campus included in the 2021 LRDP area. Table 2 provides a summary of UCR Scope 1 activity data for the 2018 GHG inventory.[30]

Table 2 Scope 1 2018 Inventory Data and Sources

Sector/Emission Source	Data Source	Activity	Units
Stationary Combustion[1]			
Natural Gas (Shell)	Annual utility data (Shell)	346,611	MMBtu
Diesel	Invoice summary	8,003	Gallons
Mobile Combustion			
Unleaded Gasoline	Fleet vehicle, fuel, and mileage data	135,192	Gallons
Compressed Natural Gas	Fleet vehicle, fuel, and mileage data	4,321	Gallon equivalents[2]
Diesel	Fleet vehicle, fuel, and mileage data	7,306	Gallons
Process and Fugitive Emissions			
Refrigerants used for Heating, Ventilation, and Air Conditioning (HVAC)	Refrigerants usage summary report	318	lbs

All presented data was provided by UCR and is based on 2018 calendar year.

[1] Natural gas is transported to the UCR main campus by Southern California Gas and is procured through Shell.

[2] CNG fuel consumption is expressed as gallon equivalents. For emissions calculations CNG fuel consumption is converted to scf where 123.57 scf CNG = 1 gasoline equivalent gallons and there are 1027 BTUs/standard cubic foot (SCF); emission factors from TCR v.2.1 (2016) Table 13.6.

Scope 2 Emissions

Scope 2 emissions reported by UCR annually were calculated using utility data from electricity service providers. Electricity usage at UCR is complex as it is acquired from a variety of sources. Specifically, UCR electricity is provided by the Imperial Irrigation District (IID), Riverside Public Utility (RPU), Southern California Edison (SCE), and SunPower. However, UCR disaggregated utility data shows that main campus electricity is only provided by RPU. Additionally, UCR reports the amount of electricity generated from installed solar photovoltaic (PV) systems on main campus. Main campus solar power is generated from SunPower photovoltaic systems located on campus at Parking Lot 30 and Lot 32, and other SunPower PV systems (Solar Farm). Rincon completed a review of the Scope 2 data and calculations and found them to be consistent with the methodologies and

[29] TCR. 2019. General Reporting Protocol Version 3.0. Available: <https://www.theclimateregistry.org/protocols/General-Reporting-ProtocolV3.pdf>. Accessed May 25, 2020.

[30] All activity data and emissions calculations presented in this report are rounded to the nearest whole number.

principals outlined in the TCR GRP.[31] Emissions are estimated by multiplying electricity consumption by an emission factor for electricity provided by RPU. Electricity generated by solar PV systems does not produce GHG emissions.

Table 3 provides a summary of the Scope 2 emission sources, the data received, activity usage, and reported units for electricity usage and solar power generation.

Table 3 Scope 2 2018 Inventory Data and Sources

Sector/Emission Source	Data Source[1]	Activity	Units
Electricity			
Riverside Public Utility	Summary spreadsheet of usage summarized by utility provider	107,088,200	kWh
SunPower Lot 30	Summary spreadsheet of production summarized by utility provider (SunEdison)	5,733,909	kWh
SunPower Lot 32	Summary spreadsheet of production summarized by utility provider (SunEdison)	1,098,690	kWh
Other Solar SunPower (Solar Farm)	Summary spreadsheet of production summarized by utility provider (SunEdison)	5,039,876	kWh

All presented data was provided by UCR and is based on 2018 calendar year.

[1.] A summary of the electricity purchased from RPU and generated by on-site solar was provided by UCR Energy Manager in the form of an Annual Utilities Summary Spreadsheet.

See Appendix A for detailed emission calculations.

Scope 3 Emissions

Scope 3 emissions reported by UCR annually have included emissions generated from faculty air travel and mobile emissions generated from staff and student employee commute. UCR tracks faculty air travel through invoices and the miles of air travel incurred from origin to destination on a calendar basis. UCR calculates staff and student/employee commute emissions calculations based on the estimated vehicle miles traveled (VMT) and associated fuel consumption by employee commuters from a commuter survey administered by UCR staff. For this inventory, Fehr & Peers (F&P) modeled all on-site VMT at the UCR main campus. Additional details on the VMT modeling are included in the CEQA Transportation Impact Analysis Appendix of the Draft EIR for the 2021 LRDP. Because the staff and student/employee commute data provided in the commuter survey is inherently included in the F&P modeled on-site VMT data, only the F&P VMT modeled data was used for calculating emissions. In addition to faculty air travel and staff and student employee commuting, emissions associated with the RTA buses that travel to and from the main UCR campus were quantified based on RTA ridership data. Waste generation are also included in the 2018 baseline inventory.

UCR provided faculty air travel miles by calendar year, commuter survey data by fiscal year, RTA ridership data by fiscal year, and waste generation by fiscal year. Due to the data sources and means of compiling the Scope 3 source data, disaggregation of UCR main campus data from total UCR campus data was not possible for faculty air travel, employee commute, and waste. However, UCR staff indicated that a majority of the listed Scope 3 activities would be associated with the main campus.[32] Therefore, it is conservatively assumed that the activity data and associated emissions sources for the Scope 3 data is representative of the main campus. Scope 3 data collection and

[31] TCR. 2019. General Reporting Protocol Version 3.0. Available: <https://www.theclimateregistry.org/protocols/General-Reporting-ProtocolV3.pdf>. Accessed May 25, 2020.

[32] Communications with UCR staff during various data review meetings and email communications.

emissions calculations follow the methodologies outlined in TCR's GRP, ICLEI Local Government Operations Protocol, and ACUPCC's Second Nature Carbon Commitment's Implementation Guide.[33,34,35] Table 4 provides a summary of the Scope 3 emission sources included in the 2018 inventory.

Table 4 Scope 3 2018 Inventory Data and Sources

Sector/Emission Source	Data Type Received	Activity	Units
Business Travel			
Faculty/Staff Air Travel	Spreadsheet summarizing faculty airline travel	8,273,344	Passenger miles
On-Site Transportation			
Passenger Vehicle	F&P Vehicle Miles Traveled spreadsheet	79,581,443	Annual VMT[1]
Light Trucks	F&P Vehicle Miles Traveled spreadsheet	607,005	Annual VMT[1]
Medium Trucks	F&P Vehicle Miles Traveled spreadsheet	577,080	Annual VMT[1]
Heavy Trucks	F&P Vehicle Miles Traveled spreadsheet	896,490	Annual VMT[1]
Transit Vehicle Transportation (RTA)	RTA UPASS – ridership data spreadsheet	554,396	# riders
Waste Generation[2]			
Waste sent to landfill, recycling center, and composting facility	Waste summary spreadsheet	4,246.5; 66% 1,008.7; 96%	MSW tons generated; MSW diversion rate C&D tons generated; C&D diversion rate

[1] Daily VMT provided by F&P is adjusted according to the Origin-Destination (O-D) Method as described in the following section.

[2] Fiscal year 2017/2018 and 2018/2019 was averaged to provide an estimate of waste in 2018 calendar year. Provided waste data included Municipal Solid Waste (MSW) and Construction & Demolition (C&D).

All presented data was provided by UCR or F&P and is based on 2018 calendar year.

Source: Data compiled by Rincon in May 2020.

[33] TCR. 2019. General Reporting Protocol Version 3.0. Available: <https://www.theclimateregistry.org/protocols/General-Reporting-ProtocolV3.pdf>. Accessed May 25, 2020.

[34] ICLEI. 2010. Local Governments Operations Protocol Version 1.1 Available: <https://icleiusa.org/ghg-protocols/>. Accessed May 25, 2020.

[35] ACUPCC. Implementation Guide Version 2.1. Available: <http://secondnature.org/wp-content/uploads/ACUPCCImplementationGuide_V2.1_.pdf>. Accessed May 25, 2020.

2.2 Scope 1 2018 Inventory Emissions Calculation Results

Results of the Scope 1 Emissions inventory are presented in

Table 5. As shown, Scope 1 emissions totaled 20,136 MT CO_2e in 2018. The largest component of UCR's Scope 1 emissions are generated by stationary combustion of natural gas in buildings and facilities, which accounts for approximately 91.4 percent of Scope 1 emissions. Figure 2 shows a breakdown of Scope 1 emissions by sector.

Table 5 Scope 1 2018 Emissions Inventory

Source	Activity Data	Emission Factor	Total Emissions ($MTCO_2e$)
Stationary Combustion[1]			
Natural Gas (Buildings and Facilities)			**18,410**
Natural Gas (Shell)	346,611 MMBtu	0.053 MT CO_2e/MMBtu	18,410
Other Stationary Combustion (Buildings and Facilities)			**82**
Diesel #2	8,003 gallons	0.010 MT CO_2e/gallon	82
Fugitive Emissions			
Refrigerants[2]			**339**
R-22	163 pounds	1,760 (GWP)	130
R-134A	17 pounds	1,120 (GWP)	9
R-404A	87 pounds	3,943 (GWP)	155
R-410A	52 pounds	1,924(GWP)	45
Mobile Combustion			
UCR Fleet Fuel Use[3]			**1,305**
Unleaded Gasoline	135,192 gallons	0.0088 MT CO_2e/gallon	1,187
Compressed Natural Gas	4,321 gallons equivalents	0.0067 MT CO_2e/gallon equivalent	29
Diesel	7,306 gallons	0.0102 MT CO_2e/gallon	75
Scope 1 Total			20,136

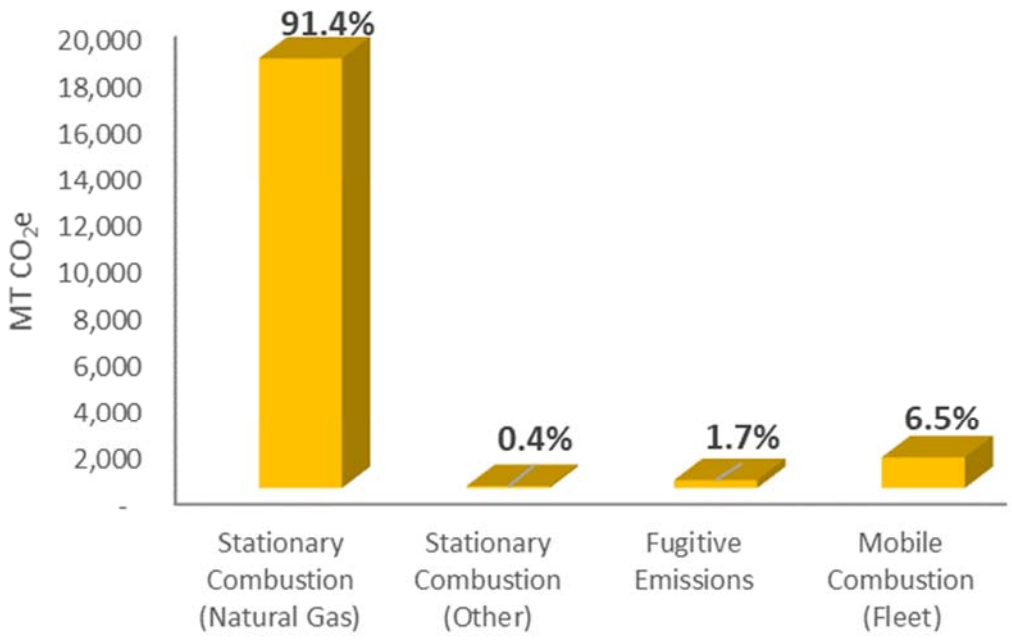
[1] The UCR Energy Manager compiled monthly invoices for all accounts associated with the main campus and provided the natural gas data in the form of a single workbook that presented monthly natural gas consumption by utility provider. Annual diesel usage on UCR main campus was provided by UCR based on a summary of monthly invoices for the year.

[2] Refrigerant data was provided in a "Usage Summary Report" document that totals usage by refrigerant type by the 2018 calendar year. Refrigerant data was disaggregated by the Sustainability Officer to provide just the refrigerant usage associated with the main campus. The total net 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.

[3] The provided fleet list and fleet fuel usage is tracked for the entire UCR campus by the Office of Sustainability and was provided for the 2018 inventory. The presented fleet vehicle fuel usage is representative of the main campus fleet fuel usage.

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

Figure 2 Scope 1 Emissions by Sector



Stationary Fuel Combustion

Natural Gas Use in UCR Facilities and Buildings

In order to calculate emissions from natural gas consumption, natural gas consumption in MMBtu is multiplied by the emission factors reported by TCR for natural gas in industrial uses[36]. TCR provides emissions factors for CO_2, CH_4 and N_20 which are multiplied by total natural consumption to calculate emissions. Overall, natural gas used at UCR has an emission factor of 0.053 MT CO_2e/MMBtu. In 2018, 346,611 MMBtu of natural gas were consumed, generating approximately 18,410 MT CO_2e.

Diesel Use in UCR Facilities and Buildings

Diesel is used on campus for stationary combustion such as in emergency generators. In order to calculate emissions from diesel consumption, diesel in MMBtu is multiplied by the emission factors reported by TCR and EPA for diesel in industrial uses. The TCR emission factor was used for CO_2, and the EPA emission factor was used for CH_4 and N_20.[37,38] Emission factors are multiplied by total diesel consumption to calculate emissions. Overall, diesel has an emission factor of 0.010 MT CO_2e/gallon. In 2018, 8,003 gallons of diesel were consumed, generating approximately 82 MT CO_2e.

[36] The Climate Registry. 2020. Default Emission Factors. Available: <https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf>. Accessed May 25, 2020.
[37] The Climate Registry. 2020. Default Emission Factors. Available: <https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf>. Accessed May 25, 2020.
[38] EPA. 2018. Emission Factors for Greenhouse Gas Inventories. Available: <https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf>. Accessed May 25, 2020.

Process and Fugitive Emissions

Refrigerants Use in UCR Facilities and Buildings

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. Therefore, 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 global warming potential (GWP) obtained from the USEPA *Emission Factors for Greenhouse Gas Inventories.*[39] 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 2021 LRDP boundary and therefore was excluded from the 2018 inventory. As such, of the 390 pounds of refrigerants emitted in 2018, 318 were accounted for in the 2018 inventory for the 2021 LRDP. The GWP of each was used to calculate MT CO_2e emissions. Overall, refrigerants accounted for approximately 339MT CO_2e in 2018.

Mobile Combustion

Fuel Use by UCR Fleet and Department Vehicles

Emission from fuel use by the UCR vehicle fleet are calculated by multiplying gallons of fuel consumed by fuel specific emissions factors obtained from CARB's EMission FACtors (EMFAC2017) model and emission factors from the USEPA *Emission Factors for Greenhouse Gas Inventories*.[40,41] 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 sources from TCR.[42] The emission factor for mobile combustion of gasoline fuel in the UCR vehicle fleet is 0.0088 MT CO_2e/gallon, 0.0067 MT CO_2e/gallon equivalents for CNG fueled vehicles, and 0.0102 MT CO_2e/gallon for diesel fueled vehicles. Based on this emissions factors, fuel use by the UCR vehicle fleet accounted for 1,305 MT CO_2e in 2018.

[39] USEPA. 2018. Emission Factors for Greenhouse Gas Inventories. Available: <https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf>. Accessed May 25, 2020.
[40] USEPA. 2018. Emission Factors for Greenhouse Gas Inventories. Available: <https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf>. Accessed May 2020.
[41] CARB. 2018. EMFAC2017 Volume III – Technical Documentation. Available: <https://www.arb.ca.gov/emfac/>. Accessed May 2020.
[42] The Climate Registry. 2020. Default Emission Factors. Available: <https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf>. Accessed May 25, 2020.

2.3 Scope 2 2018 Inventory Emissions Calculation Results

Results of the Scope 2 emissions inventory are presented in Table 6. As shown, Scope 2 emissions totaled 45,834 MT CO_2e in 2018. All Scope 2 emissions are generated by electricity from Riverside Public Utility (RPU).

Table 6 Scope 2 2018 Emissions Inventory

Sector/Emission Source[1]	Activity	Emission Factor	Total Emissions ($MTCO_2e$)
Electricity			**45,834**
Riverside Public Utility	107,088 MWh	0.428 MT CO_2e/MWh	45,834
SunPower Lot 30	5,734 MWh	0	0
SunPower Lot 32	1,099 MWh	0	0
Solar SunPower	5,040 MWh	0	0
Scope 2 Total			**45,834**

[1] UCR provided a compiled list of electricity data from all electricity providers including solar generation occurring on main campus.

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

Electricity Consumption

UCR Building and Facility Electricity Use

Emissions resulting from electricity usage in UCR buildings and facilities were estimated by multiplying annual electricity consumed by an emission factor representing the average emissions associated with generation of one megawatt hour (MWh) of electricity. Electricity from the grid is supplied to the UCR by Riverside Public Utility (RPU). UCR reported an electricity carbon intensity factor of 0.428 MT CO_2e per MWh for electricity provided by RPU.[43] Based on this emission factor and usage of 107,088,200 kWh (107,088 MWh) provided by RPU, electricity usage at UCR accounted for 45,834 MT CO_2e in 2018.

Electricity Generation

No GHG emissions are associated with the on-site solar generation of electricity. As such, this information related to electricity production by SunPower is reported solely for informational purposes, forecasting and future GHGRP implementation tracking.

[43] RPU provided the UCR Energy Manager with an emission factor of 0.428 MT CO_2e/MWh.

2.4 Scope 3 2018 Inventory Emissions Calculation Results

Results of the Scope 3 emissions inventory are presented in Table 7. As shown, Scope 3 emissions totaled 31,263 MT CO_2e in 2018. The largest component of UCR's Scope 3 emission are generated from use of passenger vehicles by staff and students, which accounts for approximately 84.3 percent of Scope 3 emissions. Figure 3 shows a breakdown of Scope 3 emissions by sector.

Table 7 Scope 3 2018 Emissions Inventory

Sector/Emission Source	Activity	Emission Factor	Total Emissions ($MTCO_2e$)
Business Travel			
Faculty/Staff Air Travel	8,273,344 passenger miles	0.000189 MT CO_2e/passenger mile	1,562
On-Site Transportation			
Mobile			**28,714**
Passenger Vehicle	79,581,443 annual VMT	0.00033 MT CO_2e/mile	26,342
Commercial Light Trucks	607,005 annual VMT	0.00066 MT CO_2e/mile	404
Commercial Medium Trucks	577,080 annual VMT	0.00106 MT CO_2e/mile	614
Commercial Heavy Trucks	896,490 annual VMT	0.00151 MT CO_2e/mile	1,354
Transit			**743**
Transit Vehicle Transportation (RTA/UPASS)[1]	554,396 annual trips	0.00134 MT CO_2e/passenger trip	743
Waste Generation[2]			**244**
UCR Generated Waste Sent to Landfills	1,456 tons	0.11 MT CO_2e/waste tonnage	160
Process Emissions Associated with Landfilling[3]	1,456 tons	0.054CO_2e/waste tonnage	79
Collection Emissions	1,456 tons	0.02 MT CO_2e/waste tonnage	(105)[4]
Transportation Emissions	1,456 tons	0.00012 $MTCO_2e$/waste tonnage/mile	4.8
Total			**31,263**

[1] Emission factor is presented here as the total annual emissions calculated for selected RTA routes divided by annual number of passengers reported. Emissions by route were calculated based on annually reported vehicle revenue miles and a weighted emission factor developed for urban buses using EMFAC2017. Based on provided fleet information from RTA in email correspondence on August 21, 2020 the fleets are operated using only gasoline and compressed natural gas, therefore the developed emission factor for Urban busses from EMFAC2017 did not include diesel fuel usage.

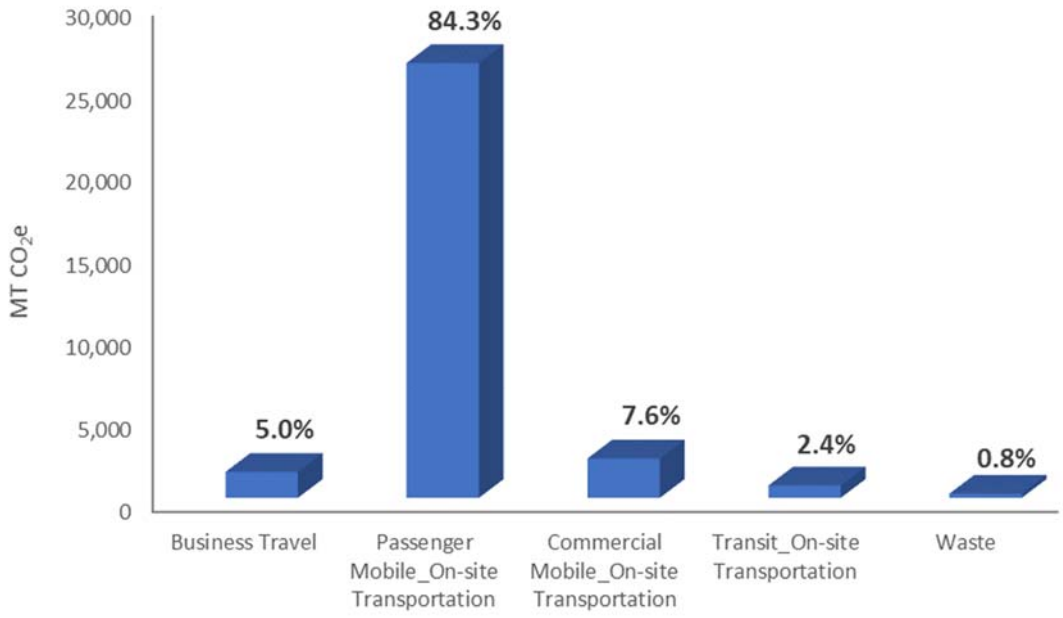
[2] Fiscal year 2017/2018 and 2018/2019 was averaged to provide an estimate of waste in 2018 calendar year. Provided waste data included Municipal Solid Waste (MSW) and Construction & Demolition (C&D).

[3] Process and stationary emissions at El Sobrante and Badlands landfill for 2018 were obtained from the EPA GHGRP database FLIGHT. Available: <https://ghgdata.epa.gov/ghgp/main.do>. The emission factor presented here is based on the combination of process emission from methane generation and stationary combustion reported at each landfill and the overall tonnage of waste landfilled at each site. It is further assumed that 50% of waste is landfilled at each site.

[4] Emissions from waste collection are excluded to avoid double counting.

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

Figure 3 Scope 3 Emissions Breakdown



Business Travel

UCR Faculty/Staff Air Travel

In order to calculate emissions from faculty and staff air travel[44], passenger mileage is multiplied by energy intensity factors per passenger mile and emission factors for aviation fuel. An energy intensity of 2,654 BTU per passenger mile was obtained from the Federal Aviation Administration (FAA) and used to convert into gallons of aviation passenger miles into gallons of aviation gasoline using a TCR emission factor.[45,46] Based on 8,273,344 passenger miles in 2018, 182,979 gallons of aviation fuel were consumed due to UCR faculty and staff air travel.

To calculate emissions, gallons of aviation fuel consumed is multiplied by emissions factors for CO_2, CH_4 and N_20. Overall, faculty and staff air travel had an emission factor of 0.000189 MT CO_2e/passenger mile. Based on this emission factor, faculty and staff air travel accounted for 1,562 MT CO_2e in 2018.

On-site Transportation

Non-Transit Vehicle Transportation

Transportation modeling for non-fleet passenger VMT attributed to UCR was calculated by F&P based on outputs of the current version of the Riverside Transportation Analysis Model (RivTAM), a regional version consistent with the Southern California Association of Governments (SCAG) transportation model. The VMT data is based on the RivTAM activity-based model and the Origin-

[44] Faculty and staff air travel emissions are only based on what is reported from Connexxus (UC system-wide travel program).
[45] Federal Aviation Administration. 2015. Aviation Emissions, Impacts and Mitigation: A Primer. Available: <https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/Primer_Jan2015.pdf>. Accessed May 25, 2020.
[46] Conversion factor for aviation gasoline is 0.120 MMBtu/gallon per TCR 2020.

Destination (O-D) method, the preferred method identified by ICLEI and TCR. The O-D method includes all trips occurring within 2021 LRDP boundaries and half of any trips that either originate or terminate within the 2021 LRDP boundaries and excludes VMT from "pass through" trips (i.e., not originating or terminating within 2021 LRDP boundaries). Like the Trip Based SCAG model, RivTAM utilizes socio-economic data (i.e., population, employment, households, workers, school enrollment, etc.), transportation analysis zones (TAZ), the highway and transit network to calculate VMT for UCR. A summary of the VMT results is presented in

Table 8.

Table 8 Estimated On-Road Transportation Emissions for 2018

Source[1]	Activity Data (Daily VMT)
Passenger	
Internal-Internal Daily VMT	2,420
½ Internal-External Daily VMT	122,523
½ External-Internal Daily VMT	127,697
Total Passenger Daily VMT Accounted for on UCR campus	**252,640**
Light Trucks	
Internal-Internal Daily VMT	52
½ Internal-External Daily VMT	935
½ External-Internal Daily VMT	941
Total Light Truck Daily VMT Accounted for on UCR campus	**1,927**
Medium Trucks	
Internal-Internal Daily VMT	3
½ Internal-External Daily VMT	912
½ External-Internal Daily VMT	918
Total Medium Truck Daily VMT Accounted for on UCR campus	**1,832**
Heavy Trucks	
Internal-Internal Daily VMT	1
½ Internal-External Daily VMT	1,420
½ External-Internal Daily VMT	1,426
Total Passenger Daily VMT Accounted for on UCR campus	**2,846**
Annual Passenger VMT[2]	**79,581,443**
Annual Light Truck VMT[2]	**607,005**
Annual Medium Truck VMT[2]	**577,080**
Annual Heavy Truck VMT[2]	**896,490**

[1.] Daily VMT provided by F&P is based on the RivTAM activity-based model and is adjusted according to the Origin-Destination (O-D) Method as described in the following section.

[2.] Based on Caltrans Data, Fehr & Peers recommends annualizing data based on 315 days/year for the study area.

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

Emissions related to passenger vehicle operation are calculated using the ICELI Community Protocol *Method TR.1.A*[47]. Equations *TR.1.B.2* and *TR.1.B.3* are used to convert provided VMT data into

[47] ICLEI. 2013. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Version 1.1.

emissions data with regional emission factors from CARB's most recent EMission FACtors (EMFAC2017).[48] EMFAC2017 VMT-based emission rates are based on the vehicle class, model years, speed, and fuel type. The inventory accounts for passenger, light trucks, medium trucks, and heavy truck vehicle types. As shown in Table 7, each vehicle class is associated with an annual VMT and an overall emission factor. In 2018, operation of non-transit vehicles at UCR accounted for 28,714 MT CO_2e. Emissions associated with passenger VMT accounted for 26,342 MT CO_2e and emissions associated with commercial VMT, aggregation of light, medium and heavy truck VMT, accounted for 2,372 MT CO_2e.

UCR EMPLOYEE COMMUTE SUBSET

UCR conducts a commuter survey every April in support of the South Coast Air Quality Management District (SCAQMD) Employee Commute Reduction Program (ECRP). Emissions from UCR employee commuting (e.g., faculty, staff, and student employees) captured by this survey are only a subset of the overall UCR on-road transportation and transit emissions associated with UCR on-site traffic as described in detail above. As such, trips associated with employee commuting have already been captured through on-road transportation VMT and transit ridership reported in Table 7. Therefore, GHG emissions associated with the employee commute subset are not reported as a stand-alone category in this report. However, emissions generated by UCR employee commuting will be quantified and discussed in the GHG Reduction Measure Quantification Report to inform the process of developing GHG reduction measures for inclusion in the GHGRS.

Transit Vehicle Transportation

UCR STAFF/STUDENT TRANSIT TRAVEL

Emissions due to UCR staff and student travel are calculated based on the UCR population that rides bus transit lines that stop, originate, or terminate on the UCR campus. 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 vehicle revenue miles (VRMs) traveled in 2018.[49] Emissions factors for motor busses are obtained from EMFAC.[50] The total emissions associated with the identified bus routes was calculated to be 3,537 MT CO_2e.

UCR provided ridership data for the 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 VRM. Based on the number of annual riders and annual VRM, it was calculated that, on average, a RTA passenger trip was 0.74 mile. Using the RTA average mileage per passenger trip (0.74 mile) and the UPASS ridership numbers (554,396) for 2018, it was estimated that UPASS riders rode a total of approximately 407,912 miles on RTA buses. This accounts for approximately 21 percent of all RTA VRMs in 2018. As such, 21 percent of the annual emissions calculated for RTA bus routes was attributed to UCR. In total, UCR students and staff rode an estimated 407,912 miles on RTA routes in 2018, producing a total of 743 MT CO_2e from transit bus operation.

[48] CARB. 2018. EMFAC2017 Volume III – Technical Documentation. Available: <https://www.arb.ca.gov/emfac/>. Accessed May 2020.
[49] RTA. 2019. Short Range Transit Plan FY19-FY21. Available: <https://www.riversidetransit.com/images/DOWNLOADS/PUBLICATIONS/SRTPS/FY2019-2021%20SRTP.pdf> Accessed July 8, 2020.
[50] CARB. 2018. EMFAC2017 Volume III – Technical Documentation. Available: <https://www.arb.ca.gov/emfac/>. Accessed May 2020.

Waste Generation

UCR Faculty/Staff Waste Generation

Solid waste emissions are generated by decomposition of waste in landfills, process emissions from methane generation associated with landfilling, stationary combustion emissions from the landfill operation, and collection and transportation of waste from where it is generated to the landfill where it is deposited. Emissions are calculated for all phases using emissions factors specific to each. UCR provided 2018/2019 fiscal year data including tonnage generated and diverted, type of waste generated from the Zero Waste Working Group as well as the location of waste pickup on campus and the hauler information from UCR staff. Because the data was provided by fiscal year, 2018 calendar year data was calculated using a weighted average of data from the 2017/2018 fiscal year and 2018/2019 fiscal year. As such in 2018, UCR generated an estimated total of 5,255 tons of solid waste. Of that, 3,800 tons or approximately 72 percent were diverted from landfills. Therefore, GHG emissions for solid waste were calculated based on 1,455.5 tons of solid waste disposed in a landfill.

An emission factor for solid waste decomposition of 0.11 MT CO_2e/wet short ton was obtained from EPA's Waste Reduction Model (WARM) v15 for California Collection, dry climate and landfills with landfill gas (LFG) recovery and flaring.[51] Based on this emission factor, solid waste decomposition accounts for approximately 160 MT CO_2e.

Solid waste generated at UCR is disposed at two facilities, the El Sobrante and Badlands Landfills. Emission factors for process emissions from methane generation associated with landfilling were obtained for both landfills.[52] Additionally, the El Sobrante Landfill reported emissions associated with stationary combustion at the landfill that were included in the overall process emission factor determined for the El Sobrante Landfill. Waste disposed at the El Sobrante Landfill has a combined process and stationary combustion emission factor of 0.021 MT CO_2e/ton, and waste disposed at the Badlands Landfill has a process emission factor of 0.087 MT CO_2e/ton. To calculate process emissions, it is assumed that solid waste is split evenly between the two landfills. Based on the above denoted emission factors for the El Sobrante and Badlands Landfill as well as the disposal of approximately 728 tons of solid waste at each landfill, process and stationary emissions are 15.5 MT CO_2e from El Sobrante and 79.1 MT CO_2e from Badlands.

Additional emissions are generated by the collection and transportation of solid waste to a landfill. Waste is first collected and hauled to a transfer station in Perris, California. UCR hauls waste generated on campus using its own vehicle fleet[53]. As such, an emission factor for collection was developed assuming that hauling vehicles are diesel powered. Based on an emission factor of 0.02 MT CO_2e/waste tonnage, collection of solid waste generated 105 MT CO_2e. As collection is performed by UCR fleet vehicles, collection emissions are excluded from the inventory to avoid double counting emissions already accounted for in the Scope 1 inventory.

After collected waste is deposited at the transfer station, it is transported to the El Sobrante and Badlands landfills. To calculate transportation emissions, it is assumed that solid waste is split evenly between the two landfills. An emission factor for transportation of waste was based on the assumptions that 50 percent of transport fuel is compressed natural gas (CNG) and 50 percent of transport fuel is diesel. According to ICLEI defaults, the emission factor for diesel is 0.00014

[51] USEPA. 2020. WARM Model. Available: <https://www.epa.gov/warm/versions-waste-reduction-model-warm#15>. Accessed May 2020.
[52] USEPA. 2020. GHG FLIGHT. Available: <https://ghgdata.epa.gov/ghgp/main.do#>. Accessed May 2020.
[53] Per Feb 14, 2020 email from UCR Facilities Services, UCR hauls own waste to be landfilled to the CR&R facility in Perris. To avoid double counting of operation of fleet vehicles for waste collection, collection emissions will not be included. Collection emissions based on assumption the UCR fleet vehicles for waste hauling are diesel (ECF Diesel = 0.02), ICELI Default equation SW.6.

$MTCO_2e$/mile and the emission factor for CNG is 0.00010. Based on an overall emissions factor of 0.00012 $MTCO_2e$/waste tonnage/mile and a distance of 28 miles traveled to the Badlands Facility and 27 miles to the El Sobrante Landfill, transportation of waste generated 4.8 MT CO_2e in 2018. In total, solid waste emissions accounted for 244 MT CO_2e in 2018.

2.5 2018 Emissions Inventory Results by Scope Summary

Overall UCR GHG emissions were estimated to be 97,232 MT CO_2e in 2018. The largest component of UCR emissions were Scope 2 emissions, which account for 45,834 MT CO_2e or approximately 47 percent of overall emissions. Scope 3 emissions were the second largest, accounting for 31,263 MT CO_2e or approximately 32 percent of overall emissions. Scope 1 emissions were the smallest component, accounting for 20,136 MT CO_2e or approximately 21 percent of overall emissions. Emissions are summarized in

Table 9 and Figure 4.

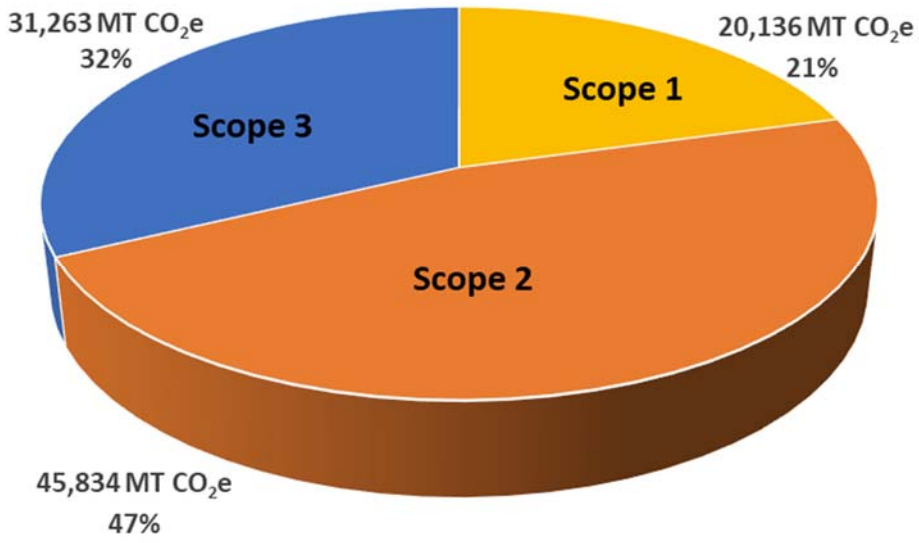
Table 9 2018 GHG Inventory

Scope	MT CO_2e[1]	Percent of Total Emissions	Percent within Scope
Scope 1	**20,136**	**21%**	**100.0%**
Stationary Fuel Combustion (Natural Gas)	18,410	19%	91.4%
Stationary Fuel Combustion (Diesel)	82	0.1%	0.4%
Process and Fugitive Emissions (Refrigerants)	339	0.3%	1.7%
Mobile Fuel Combustion (Fleet)	1,305	1%	6.5%
Scope 2	**45,834**	**47%**	**100.0%**
Electricity Consumption	45,834	47%	100.0%
Scope 3	**31,263**	**32%**	**100.0%**
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.

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

Figure 4 2018 UCR Emissions by Scope



2.6 Progress Towards the State's 2020 GHG Emissions Goal

Progress towards the State's 2020 GHG emissions goal has been tracked using inventories developed for UCR-wide emissions which include both the 2021 LRDP facilities as well as additional satellite facilities. For the 2018 calendar year, the UCR Climate Change Work Group (CCWG) reported 104,767 MT CO_2e from UCR-wide operations.[54] As such, UCR-wide emissions operations appeared to reduce by 66,210 MT CO_2e in comparison to 2009 levels. For the purposes of the 2021 LRDP GHGRS, the 2018 calendar inventory reported herein includes only emissions associated with the 2021 LRDP boundary area.

Based on the 2019 Annual Report on Sustainable Practices published by UCOP, UCR-wide emissions were 22,600 MT CO_2e above the UCR 2020 emissions goal (e.g., 1990 level [82,167 MT CO_2e]). As such, UCR would need to reduce UCR-wide emissions by approximately 22,600 MT CO_2e or an additional 21.5 percent by 2020 to meet the 2020 goal established by the UC Policy.[55]

The 2021 LRDP boundary represents main campus but does not include satellite campuses, therefore, it is not appropriate to directly compare the inventory developed for the main campus to the 1990 UCR-wide emissions baseline. As such, the 1990 UCR-wide baseline emissions levels must be scaled appropriately to allow for an assessment of the UCR's main campus progress towards the 2020 GHG emissions goal. As described in detail in Section 4.1, *Targets Baseline Year,* the main campus makes up approximately 90 percent of UCR-wide emissions based on a comparison of the CCWG prepared UCR-wide 2018 inventory and the main campus 2018 inventory prepared for the 2021 LRDP. The 2018 GHG inventory prepared by CCWG includes disaggregated data such that main

[54] UCR-wide emissions inventory calculated annually by UCR CCWG include all UCR operations activity. The 2018 inventory presented herein is limited in scope to the operations associated with the 2021 LRDP boundary.
[55] UC. 2019. Sustainable Practices Policy. Available: <http://ucal.us/suspolicy>. Accessed July 8, 2020.

campus operations were distinguishable from UCR-wide operations. To ensure the comparison between the two inventories was consistent, only emission sources included in both the CCWG inventory and the 2018 main campus inventory were evaluated to determine relative contribution of the main campus to UCR-wide emissions.[56] As previously detailed not all emission sources could be disaggregated, however, the primary GHG emissions source is related to energy use which was disaggregated by the UCR staff; main campus natural gas usage was approximately 80 percent of UCR-wide natural gas utility data while electricity usage on main campus made up approximately 90 percent of UCR's total electricity consumption.[57] Business air travel, on-site transportation, and mobile combustion from UCR fleet were not disaggregated. However, UCR staff confirmed that a vast majority of such emissions are associated with main campus and it is appropriate to attribute these sources of emissions to main campus.[58] Summation of the main campus 2018 inventory emission sources that are included in the CCWG reports (i.e. natural gas combustion, fugitive emissions from refrigerants, mobile combustion from fleet vehicles, electricity consumptions, business air travel, and on-site commuter transportation emissions) result in 93,791 MT CO_2e. This is approximately 90 percent of the UCR-wide emissions reported by CCWG in 2018, 104,767 MT CO_2e.[59] Therefore, scaling the UCR-wide 1990 emissions levels down by 10 percent to just the main campus, results in a scaled main-campus 1990 emissions level of 73,623 MT CO_2e. As such, the full 2018 inventory developed for the 2021 LRDP discussed in Section 2.5, *2018 Emissions Inventory Results by Scope Summary*, shows that main-campus 2018 GHG emissions levels (97,232 MT CO_2e) are approximately 23,609 MT CO_2e above the scaled main-campus 1990 baseline. UCR would need to reduce 2020 main campus emissions by approximately 23,609 MT CO_2e or approximately 24.2 percent to be consistent with the 2020 goal established by the UC Policy.

[56] The CCWG inventories include natural gas combustion, fugitive emissions from refrigerants, UCR fleet mobile combustion emissions, electricity consumption, business air travel, and on-site transportation.

[57] UCR staff confirmed the CCWG data included UCR-wide utility. Therefore, utility energy data was disaggregated prior to being provided to Rincon. See the University of California at Riverside 2021 Long Range Development Plan. Greenhouse Gas Emissions Inventory and Forecast Data Evaluation Memorandum (Final) delivered on January 12, 2021.

[58] Confirmation was made verbally during the April 24, 2020 call with the UCR team during the review of provided data.

[59] The CCWG reported UCR-wide emissions from 2018 as 104,767 MT CO_2e including the following emission sources: natural gas combustion, fugitive emissions from refrigerants, mobile combustion from fleet vehicles, electricity consumptions, business air travel, and on-site commuter transportation emissions. Summation of only those same sources from the 2021 LRDP (i.e., main campus) 2018 inventory is 93,791 MT CO_2e. (93,791/104,767 = 90%)

3 2025, 2030, & 2035 GHG Emissions Forecasts

3.1 Forecast Data and Methodology

A GHG emissions inventory sets a reference point for a single year. However, annual emissions change over time due to factors such as population growth, increased vehicular fuel efficiency, increased renewables sources from the electricity providers, new development as well as new technologies and policies. A GHG emissions forecast accounts for projected growth and presents an estimate of GHG emissions in future years.

This section calculates a GHG emissions forecast for UCR through 2035[60] in a *business-as-usual* (BAU) scenario, and then quantifies the reduction that State regulations will have on the UCR GHG emissions forecast and presents the results in an *adjusted scenario* forecast. The *adjusted scenario* incorporates the effect of State regulations that would reduce UCR GHG emissions to provide a more accurate picture of future emissions growth.

Forecast Years (2025, 2030, and 2035)

The GHG baseline inventory provides accurate reference points for emissions levels in past years for the UCR main campus as defined above. Because annual emissions of the UCR main campus as defined in the 2021 LRDP will change over time due to increased student demand and enrollment, increased employment, and development and operational changes to accommodate the enrollment increase, an emissions forecast which accounts for these changes has been prepared. Forecasting future GHG emissions also allows for a comparison between the forecasted GHG emissions and the reduction target. The gap between these two points is what will ultimately allow for accurate climate action planning via development of GHG emissions reduction measures that assist UCR in achieving its GHG reduction targets.

The future GHG emissions forecast models the maximum projected build out for the Land Use Designations as defined by the 2021 LRDP while also accounting for anticipated GHG reductions from State-level policies. Forecast results are shown for the years 2025, 2030, and 2035. Forecast results are also shown for 2045 to illustrate the anticipated future trajectory of GHG emissions beyond 2035, which is necessary for 2035 target setting. In order to develop a UCR 2035 target, the forecast must extend past 2035 (the 2021 LRDP planning horizon year). Forecasted data for 2045 is presented for informational purposes, as it is understood that a future LRDP update will occur to account for growth post-2035 at which time an updated emissions forecast would also need to be conducted. The forecast years align with the following State and UC established target years for GHG emissions:

- 2025: UC Sustainable Practices Policy Scopes 1 and 2 carbon neutrality policy goal
- 2030: SB 32 target year
- 2035: 2021 LRDP planning horizon year
- *2045: EO B-55-18 target year for carbon neutrality*[61]

[60] The 2021 LRDP horizon year is 2035 therefore the forecast is developed to go through 2035.

[61] The State 2045 target is presented in the forecast to provide a trajectory post-2035; this is necessary for UCR 2035 target setting purposes. Note that the 2045 forecast information has been included in the tables throughout this forecast section for informational purposes.

- *2050 or sooner: UC Sustainable Practices Policy Scopes 1, 2, and 3 carbon neutrality policy goal*[62]

2021 Building Space and Population Projections Data

GHG forecasted emissions are based on campus business-as-usual energy-use trends, the anticipated impact of 2021 LRDP developments, the anticipated impact of existing energy efficiency and GHG reduction programs, and campus growth assumptions consistent with the 2021 LRDP. Per the 2021 LRDP, growth modeling is based on the anticipated 2021 LRDP building growth, current student population, historic student growth trends for UC Riverside, delivery time required to build new facilities, and infrastructure needs. Projected building square footage is presented in assignable square feet (asf), or the area within the interior walls of a room that can be assigned to a program. However, GHG emissions generated from energy consumption and building construction depend on the total building space and materials necessary to construct the building, not just the area within the interior walls of a building. Therefore, for the purposes of forecasting operation and construction, asf is converted to gross square footage (gsf) using the standard space planning assumption ratio of 1.5 per UCR direction.

Table 10 and Table 11 provide a summary of the 2021 LRDP building and population growth assumptions in the 2035 horizon year used in the GHG emissions forecasting. Per the 2021 LRDP, growth modeling is based on the anticipated 2021 LRDP building growth, current student population, historic student growth trends for UC Riverside, delivery time required to build new facilities, and infrastructure needs. Projected building square footage is presented in assignable square feet (asf), or the area within the interior walls of a room that can be assigned to a program.[63] However, GHG emissions generated from energy consumption and building construction depend on the total building space and materials necessary to construct the building, not just the area within the interior walls of a building. Therefore, for the purposes of forecasting operation and construction, asf is converted to gross square footage (gsf) using the standard space planning assumption ratio of 1.5 per UCR direction.

Table 10 UCR 2021 LRDP Building Space Program Projections

Land Use	2018-2035 Building Change (asf)	New Construction (gsf)
Academics and Research		
Classroom and Services	176,970	265,455
Teaching Lab and Service	63,071	94,607
Open Lab and Service	12,757	19,136
Research Lab and Service	178,090	267,135
Total	**430,888**	**646,332**
Academic Support		
Offices and Services	586,581	879,872
Library & Collaborative Learning Space	177,238	265,857
Assembly and Exhibit	62,012	93,018
Other Department Space	70,398	105,597

[62] Note that 2050 forecast information has not been included in the tables throughout this forecast section, because the UCR target trajectory was developed based on alignment with the State EO B-55-18 2045 target, which supersedes the UC Sustainability Practices Policy 2050 target.

[63] Assignable Square Feet (asf) is defined as the area measured within the interior walls of a room that can be assigned to a program and does not include circulation, mechanical, restrooms, or building service spaces. Per UCR direction the standard space planning assumption of 1.5 is used to convert asf to gsf.

Total	**896,229**	**1,344,344**
Student Life		
Residential	2,117,973	3,176,960
Residential Dining	38,725	58,088
Student Health	10,383	15,575
Student Union	90,300	135,450
Recreation Indoors	65,160	97,740
Recreation Outdoors	4 (acres)[1]	0
Athletics	0	0
Total	**2,322,541**	**3,483,812**
Other Campus Space		
Corporation Yard	0	0
2021 LRDP Total	**3,649,658**	**5,474,487**

[1] Negligible emissions are associated with the growth of outdoor recreation space therefore change in recreation space is not included in the inventory or forecast and presented here for information purposes only related to anticipated growth under the 2021 LRDP.

Source: 2021 LRDP Program Model

Table 11 UCR 2021 LRDP Campus Population Projections

Land Use	Baseline (2018/2019)	2021 LRDP Horizon Year (2035/2036)	Net 2021 LRDP Increase from Baseline
Students			
Undergraduates	20,581	28,000	7,419
Graduates	3,341	7,000	3,659
Total	**23,922**	**35,000**	**11,078**
Faculty and Staff			
Ladder Rank Faculty	841	1,285	444
Other Instructional Faculty	332	486	154
Non-Teaching Academic Appointment	529	774	245
Non-Academic Staff	3,037	5,000	1,963
Total	**4,739**	**7,545**	**2,806**
Total Campus Population	**28,661**	**42,545**	**13,884**

Source: 2021 LRDP Program Model

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 baseline GHG inventory. However, for the purposes of forecasting emissions, interim projects emissions have been added to the 2018 baseline year (i.e., inventory year) emissions to account for total emissions associated with projects built between the invenotry year and adoption of the proposed 2021 LRDP. Interim projects are described in further detail in the *Interim Projects Building Space Data* subsection below.

In addition, transportation related emissions are forecast based on the annual VMT estimates are shown in Table 12. Future VMT estimates with and without the 2021 LRDP buildout were modeled and provided by Fehr & Peers for 2030, 2035, and 2045.[64]

Table 12 Forecast Year Annual VMT with 2021 LRDP Buildout

Year	2030	2035	2045[2]
Vehicle Class[1]			
Passenger	127,676,851	132,342,053	141,672,456
Light Trucks	1,185,276	1,224,441	1,302,770
Medium Trucks	1,100,867	1,098,630	1,094,157
Heavy Trucks	1,715,753	1,738,033	1,782,593
Total	**131,678,748**	**136,403,157**	**145,851,976**

[1.] Daily VMT with 2021 LRDP buildout for each of the indicated years was provided by Fehr & Peers. The data is adjusted according to the Origin-Destination (O-D) Method previously described to obtain daily VMT attributed to UCR. on Caltrans Data, Fehr & Peers recommends annualizing data based on 315 days/year for the study area.

[2.] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for informational purposes and is utilized for developing a trajectory post-2035 to allow for UCR 2030 and 2035 target setting.

Source: Fehr & Peers 2020. Draft Traffic Analysis

Interim Projects Building Space Data

There are several interim projects that have occurred or are in progress on the UCR main campus within the boundary of the 2021 LRDP post the 2018 calendar year and, therefore, would not be accounted for within the 2018 baseline GHG inventory. As these projects are under UCR operational control and are within the 2021 LRDP area, though not formally included in the 2021 LRDP, the construction and operational emissions associated with these interim projects are added to the GHG emissions forecasting to provide an all-encompassing and, thus, conservative forecast for the UCR main campus in 2018. The total 2018 baseline GHG emissions with the interim construction projects that would have been conducted prior during 2018 is 97,333 MT CO_2e.

Interim projects are not associated with the 2021 LRDP and have or will occur prior to its implementation and are outside of the scope of the 2021 LRDP projected growth. Construction and operational GHG emissions associated with the interim projects have been previously quantified in separate standalone UCR project-level CEQA documents using California Emissions Estimator Model (CalEEMod), and the respective results have been provided to Rincon 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). The CEQA documents prepared for Batchelor Hall and Pierce Hall renovation did not include emission estimations. The two renovation projects primarily consist of energy upgrades; therefore, construction emissions are assumed to be negligible. The net change in energy consumption due to energy improvements was estimated based on communications with UCR Facilities that indicated a 16 percent reduction of energy consumption at Pierce Hall and was incorporated into the forecast. As the Batchelor Hall Renovation project is not yet under contract it was conservatively assumed that there would be no change in energy consumption from this project. To provide a conservative forecast analysis, interim project emissions were accounted for as Scope 3 emissions in the forecasts.

[64] Fehr and Peers. 2020. UCR VMT Summary Spreadsheet.

Rincon received a list of eleven interim projects that were constructed post-2018 and are not included in the 2021 LRDP, but that are included in the forecast.[65] Interim projects include: North District Development (NDD) Phase 1, North District Development (NDD) Phases 2-5, Dundee Glasgow, The Barn, Plant Growth Environments Facility (PGEF), Student Success Center (SSC), Parking Structure 1 (PS1), Pierce Hall Renovation, Batchelor Hall Renovation, Student Health & Counseling Center, and School of Medicine Building 2.[66,67,68,69,70,71,72]

Subsequent to the completion of the Greenhouse Gas Emissions Inventory and Forecast Data Evaluation Memorandum sent to UCR on May 15, 2020, two projects, the Class Lab & Teaching Facility and School of Business were removed from the interim projects category, as it has been confirmed that these two projects are already incorporated into the 2021 LRDP program model.[73]

Forecast Methodology

Operation-related GHG emissions from building electricity and fuel use; utility electricity generation/transmission; vehicle fuel use by UCR fleet vehicles/employee and student commute; refrigerant process/storage; waste generation, as well as construction-related GHG emission from building demolition/construction materials and construction vehicle/equipment fuel use is forecasted using various models and plan-specific data and reports provided by UCR, discussed below.

The UCR GHG emissions forecast that accounts for building demolition, construction and operation is unique in that it accounts for the emissions savings of buildings that will be removed and replaced under the 2021 LRDP. Demolished buildings will be replaced by new facilities built according to the latest standards for energy efficiency. Therefore, operational GHG emissions of existing buildings that will be replaced under the 2021 LRDP are subtracted from the forecast and replaced by the operational GHG emissions associated with the replacement structures. The forecast also accounts for the GHG emissions associated with the demolition of existing structures and construction of replacement structures that will occur under the 2021 LRDP.

[65] The updated list of interim projects including associated CEQA documentation of construction and demolition emissions and related information details were provided by UCR between June 24, 202 and July 10, 2020.

[66] UCR. 2019. North District Development Plan Project 3 958080: Revised Draft Environmental Impact Report SCH #2018061044. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2019-04/ndd_revised_deir_all_sections.pdf>. Accessed May 1, 2020.

[67] UCR. 2018. Dundee Residence Hall and Glasgow Dining Project UCR Project # 950570: Addendum No. 2 to the 2005 UC Riverside Long-Range Development Plan Environmental Impact Report. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2019-04/dundee-glasgow_combined_addendum_06-2018.pdf>. Accessed May 1, 2020.

[68] UCR. 2019. Plant Growth Environments Facility Project No. 950558: Final Initial Study/Mitigated Negative Declaration State Clearinghouse No. 2019029085. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2019-04/pgef_final_is_mnd_april_2019.pdf>. Accessed May 1, 2020.

[69] UCR. 2017.Final Initial Study/Mitigated Negative Declaration: Barn Expansion UCR Project No. 950493 SCH No. 2017041076. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2019-04/barn_expansion_final_is_mnd-august_2017.pdf>. Accessed June 11, 2020.

[70] UCR. 2019. UCR Student Success Center Project No. 950512: Final Initial Study/Mitigated Negative Declaration State Clearinghouse No. 2019089058. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2019-10/Final_SSC_ISMND-Oct2019_1.pdf>. Accessed May 1, 2020.

[71] UCR. 2020. UCR Parking Structure 1 Project No. 956553: Final Initial Study/Mitigated Negative Declaration State Clearinghouse No. 2019129026. Available: <https://cpp.ucr.edu/sites/g/files/rcwecm2356/files/2020-01/UCR%20PS1_Final%20IS-MND_1-27-20.pdf>. Accessed May 1, 2020.

[72] Batchelor Hall and Pierce Hall were mechanical renovations that were assessed through Categorical Exemption. Therefore, net new emissions from the renovation project are based on improvements in building energy intensity (EUI) from the current building code, assumed to be 2016 -Title 24.

[73] Email communication with Stephanie Tang, UCR Campus Environmental Planner, on June 26, 2020.

For all forecast years and scenarios, the CalEEMod version 2016.3.2[74] was used to quantify emissions associated with the demolition of existing buildings and construction of future buildings under the 2021 LRDP. UCR provided a list of buildings and the associated building square footage that would be demolished in 5 to 10 years and 10 to 15 years. Emissions associated with demolition were calculated via CalEEMod based on the gross square footage of the buildings to be demolished as defined by UCR. Similarly, emissions associated with construction of new buildings was 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. See Appendix A for details regarding the new building size in gsf provided by UCR and CalEEMod land use type applied to the 2021 LRDP building data. Demolition and construction emissions were amortized across 2021 to 2035 and added to the forecasted emissions. The energy use intensity (EUI) factors developed by Brightworks Sustainability for the *UCR Program Concept Energy Analysis* (2016) and building gross square footage provided by UCR was utilized to estimate annual natural gas and electricity use by building type for both existing buildings and future building.[75] Energy use for existing buildings was based on the EUI associated with the current level of energy performance at the time of the study, while energy use for future buildings was based on the EUI for the escalating California Title-24 code. UCR distinguished existing and future buildings by building or land use type allowing for the application of the appropriate EUI. Existing building EUIs in 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 by UCR in the Brightworks study to have EUIs of 65, 149, 57 and 107 kBtu/sf-yr for academic/admin, lab/complex, residential, and social building types, respectively. EUIs for existing and future buildings were applied to the 2021 LRDP buildings gsf based on building type defined as either academic/admin, lab/complex, residential, or social. See Appendix A for details regarding designation of 2021 LRDP buildings by type and calculations of energy use based on the EUI. Additional energy use improvements resulting from other legislation or UC Sustainability Policies was incorporated under the legislative adjusted scenario as described in detail in the following sections.

Business As Usual Forecast Scenario Methodology

The BAU scenario forecast provides an estimate of how GHG emissions would change in the forecast years if consumption trends continue as in 2018, absent any new regulations which would reduce emissions. Indicator growth rates were developed from 2018 activity levels and applied to the various emissions sectors to project future year emissions.

[74] California Air Pollution Officers Association (CAPCOA). 2016. CalEEMod Version 2016.3.2. user guide and program documentation. Available: <http://www.aqmd.gov/caleemod/>. Accessed: March 10, 2020.

[75] A distinct EUI was developed for the following specific building types: academic/admin, lab/complex, residential, social.

Table 13 contains a list of growth factors used to develop the business-as-usual scenario forecast. The BAU growth factors were then multiplied by the population or service person growth rates and anticipated building square footage growth to develop the BAU emissions forecast.

Table 13 BAU Forecast Scenario Growth Metrics

Sector	Growth Metrics
Energy	
Baseline Electricity (kWh/SF)	24.765
Baseline NG (Therms/SF)	0.722
Baseline Diesel (Gal/SF)	0.002
Fugitive	
Baseline Refrigerant (MT CO_2e/SF)	0.00007
Campus Fleet	
Gasoline (Gal/CP)	4.7
Diesel (Gal/CP)	0.3
CNG (scf/CP)	0.2
Business Travel	
Air Travel (miles per Staff)	1,746
On Site Transport	
Passenger (VMT/CP)	2,777
Light-Heavy Duty (VMT/CP)	21
Medium-Heavy Duty (VMT/CP)	20
Heavy-Heavy-Duty (VMT/CP)	31
Public Transit	
Attributed VMT per CP	14.0
Waste	
Waste Generation (short tons/CP)	0.0508

kWh: kilowatt hour; CP: campus population (students, faculty and staff) MT CO_2e: metric tons of carbon dioxide equivalent; VMT: vehicle miles traveled

See Appendix A for detailed emission calculations and forecast methodology. Growth metrics are developed based on existing conditions at UCR as presented and used in the 2018 inventory.

State Regulations Adjusted Emissions Forecast Scenario Methodology

The State regulations adjusted scenario estimates future UCR emissions under codified GHG reduction strategies currently being implemented at the State and federal level. The 2017 Scoping Plan Update identified several existing State programs and targets, or known commitments required by statute which can be assumed to achieve GHG reductions without UCR action, such as increased fuel efficiency standards of mobile vehicles. The following known commitments are factored into the adjusted scenario projection.

TAILPIPE EMISSIONS

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. Signed into law in 2002, AB 1493 (Pavley Standards) required vehicle manufacturers to reduce GHG emissions from new passenger

vehicles and light trucks from 2009 through 2016, with a target of 30 percent reductions by 2016, while simultaneously improving fuel efficiency and reducing motorists' costs.[76]

Prior to 2012, mobile emissions regulations were implemented on a case-by-case basis for GHG and criteria pollutant emissions separately. In January 2012, CARB approved a new emissions-control program (the Advanced Clean Cars program) combining the control of smog, soot causing pollutants, and GHG emissions into a single coordinated package of requirements for passenger cars and light trucks model years 2017 through 2025. The Advanced Clean Cars program coordinates the goals of the Low Emissions Vehicles, Zero Emissions Vehicles, and Clean Fuels Outlet programs. However, in 2019 the federal government issued a final action entitled the One National Program on Federal Preemption of State Fuel Economy Standards Rule, which finalized Part I of the Safer, Affordable, Fuel-Efficient (SAFE) Vehicles Rule and stated that federal law preempts State and local tailpipe GHG emissions standards as well as zero emission vehicle mandates. While still in flux, under the SAFE Rule discussed above, fuel economy and GHG emission standards for new vehicles may not improve beyond model year 2020. According to CARB, the federal rollback proposal of the remaining Advanced Clean Cars Program standards would increase global warming emissions by 14 million metric tons per year by 2025.[77]

Reductions in GHG emissions from the above referenced standards were calculated using the CARB EMFAC2017 model for Riverside County. The EMFAC2017 model integrates the estimated reductions into the mobile source emissions portion of the model.[78]

As of the time of this writing, the federal Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part 2 has been posted in the Federal Register but was intended to take effect on June 29, 2020. This new rule rolls back California fuel efficiency standards for on-road passenger vehicles, so that cars and trucks will now only achieve a 40.4 mpg industry average by 2026 compared to the 46.7 mpg projected requirement under the previous California Advanced Clean Car Program/federal Corporate Average Fuel Economy (CAFE) standards. No methodology currently exists for extracting or altering the on-road passenger vehicles fuel efficiency standard aspect of the Emissions Factors (EMFAC) model[79] used to calculate forecasted vehicle GHG emissions. In addition, the California Climate Change Scoping Plan does not yet address or provide guidance related to this pending change in fuel efficiency standards with regard to GHG emissions determination. Furthermore, California is 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[80] and on the CARB website.[81] Furthermore, in February 2021, the U.S. Department of Justice asked courts to put the litigation on hold while the administration "reconsidered the policy

[76] CARB. 2013.Clean Car Standards – Pavley, Assembly Bill 1493.

[77] CARB. 2018. California moves to ensure vehicles meet existing State greenhouse gas emissions standards. Available: <https://ww2.arb.ca.gov/news/california-moves-ensure-vehicles-meet-existing-state-greenhouse-gas-emissions-standards-0>. Accessed May 25, 2020.

[78] Additional details are provided in the EMFAC2017 Technical Documentation, July 2018. Available: <https://www.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf>. Accessed May 25, 2020. The Low Carbon Fuel Standard (LCFS) regulation is excluded from EMFAC2017 because most of the emissions benefits due to the LCFS come from the production cycle (upstream emissions) of the fuel rather than the combustion cycle (tailpipe). As a result, LCFS is assumed to not have a significant impact on CO_2 emissions from EMFAC's tailpipe emissions estimates.

[79] The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California and to support CARB regulatory and planning efforts to meet Federal Highway Administration transportation planning requirements.

[80] *State of California et al. v. Chao et al.* (Case 1:19-cv-02826). Available: <https://oag.ca.gov/system/files/attachments/press_releases/California%20v.%20Chao%20complaint%20%2800000002%29.pdf>. Accessed May 2020.

[81] CARB. Waiver Timeline. Available: <https://ww2.arb.ca.gov/resources/documents/carb-waiver-timeline>. Accessed May 2020.

decisions of a prior administration." Therefore, the UCR adjusted forecasts have not been modified to reflect the new SAFE Rule Part 2.

INNOVATIVE CLEAN TRANSIT

In December 2018, the CARB adopted the Innovative Clean Transit (ICT) regulations, requiring all transit agencies to develop a plan to achieve zero emission bus (ZEB) 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.

TITLE 24

Although it was not originally intended to reduce GHG emissions, California Code of Regulations Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, was adopted in 1978 in response to a legislative mandate to reduce California's energy consumption, which in turn reduces fossil fuel consumption and associated GHG emissions. The standards are updated triennially to allow consideration and possible incorporation of new energy-efficient technologies and methods. The update process reviews the standards with the legislative directive of "[r]educing of wasteful, uneconomic, inefficient, or unnecessary consumption of energy." (Pub. Resources Code, § 25402). Starting in 2020, new residential developments will include on-site solar generation and near-zero net energy use. For projects implemented after January 1, 2020, the California Energy Commission estimates the 2019 standards will reduce consumption by seven percent for single-family residential buildings and 30 percent for non-residential buildings, relative to the 2016 standards. Overall, the 2019 standards are anticipated to use about 53% less energy than structures developed under the 2016 standards, which in turn were 28% more efficient that the 2013 standards. These percentage savings relate to heating, cooling, lighting, and water heating only and do not include other appliances, outdoor lighting not attached to buildings, plug loads, or other energy uses. The calculations and GHG emissions forecast assume all growth in the residential and commercial/industrial sectors is from new construction compliant with the latest Title 24 Standards.

The 2017 Scoping Plan Update calls for the continuation of ongoing triennial updates to Title 24 which will yield regular increases in the mandatory energy and water savings for new construction. The State is already in the process of preparing 2022 building standards and energy efficiency requirements.[82] Future updates to Title 24 standards for residential and non-residential alterations past 2023 are not taken into consideration as the 2022 standards have not yet been adopted.

RENEWABLES PORTFOLIO STANDARD & SENATE BILL 100

Established in 2002 under SB 1078, enhanced in 2015 by SB 350, and accelerated in 2018 under SB 100, California's RPS is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, publicly owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 60 percent of total procurement by 2030. The RPS program further requires these entities to increase procurement from GHG-free sources to 100 percent of total procurement by 2045.

RPU provides the grid electricity used by UCR and is subject to the RPS requirements. In 2018, the inventory year, 35 percent of RPU's total procurement was from eligible renewable energy

[82] CEC. 2020. 2022 Building Energy Efficiency Standards. Available: <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency>. Accessed May 2020.

resources. UCR forecast emissions factors include reductions based on compliance with RPS requirements through 2045. As such, the percent of eligible renewable energy resources procured by RPU was interpolated for interim years assuming that RPU achieved the following required targets: 60 percent eligible renewable energy resources in 2030, and 100 percent eligible renewable energy resources in 2045.

UC Policy on Sustainable Practices

UC has committed to a number of goals related to GHG emissions reduction. The original GHG reduction goal set by the UC Policy was to reduce GHG emissions to 2000 levels by 2014, to 1990 levels by 2020, and ultimately climate neutrality as soon as feasible.[83] The UC Policy has been updated to included goals beyond 2020. The most recent update of the UC Policy requires carbon neutrality for Scope 1 and Scope 2 emissions by 2025 and carbon neutrality for Scope 3 emissions by 2050 or sooner.

The impact of existing UC policies has not been factored into the adjusted forecast scenario included in this report.

3.2 BAU Forecast Scenario Calculation Results

Under the BAU forecast scenario, UCR GHG emissions are projected to continue increasing through 2035 as shown in

Table 14. This increase is driven primarily by an increase in energy usage due to building space growth under the 2021 LRDP buildout and increased on-site transportation due to campus population growth. As previously discussed, the BAU provides an estimate of how GHG emissions would change in the forecast years if consumption trends and emission factors continue as in 2018, absent any new regulations which would reduce emissions or increase building energy efficiency. Table 13 presents the growth factors utilized for BAU forecasting in addition to campus population growth and building projections presented in Table 10 and Table 11, respectively. Emissions generated by demolition and construction of projects under the 2021 LRDP also contribute to the increase. Emissions from construction and demolition projects between 2021 and 2035 were calculated using CalEEMod and emissions were amortized across the 2021 LRDP timeframe of 14 years (i.e., 2021 to 2035). Amortized construction and demolition emissions were added to year starting in 2021. Construction and operational emissions associated with interim projects were calculated using CalEEMod and were added to the specific year(s) that construction is assumed to occur and operation to start based on the construction schedule information provided by UCR.[84] 2035 emissions are projected to be 279,931 MT CO2e under the business-as-usual scenario, an increase of approximately 288 percent above the 2018 emissions level of 97,333 MT CO2e.

[83] UC. Annual Report on Sustainability Practices. 2010. Available: <https://regents.universityofcalifornia.edu/regmeet/mar10/gb6.pdf>. Accessed July 14, 2020.

[84] UCR provided information regarding construction timeframe and operational year via email communication with Stephanie Tang, UCR Campus Planner, on June 26, 2020. Only energy emissions from interim project operation are included in the forecast as emissions associated with waste, mobile, area, etc. are captured in the forecast via other growth factors.

Table 14 BAU Forecast Scenario Summary by Sector by Target Year

Scope	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2045[1] (MT CO_2e)
Scope 1				
Natural Gas	33,834	45,674	57,629	57,629
Other Fuels	138	178	218	218
Building and Facility Refrigerants	569	734	899	899
UCR Fleet (Unleaded)	1,440	1,611	1,782	1,782
UCR Fleet (Diesel)	35	39	44	44
UCR Fleet (CNG)	90	101	112	112
Total Scope 1 Emissions	**36,107**	**48,337**	**60,683**	**60,683**
Scope 2				
Electricity	88,393	122,028	156,320	156,320
Total Scope 2 Emissions	**88,393**	**122,028**	**156,320**	**156,320**
Scope 3				
UCR Business Travel	1,943	2,215	2,487	2,487
On-Road Transportation (Passenger)	35,628	42,261	43,805	46,894
On-Road Transportation (Commercial/Heavy Duty)	3,643	4,551	4,609	4,723
Public Transit	891	997	1,103	1,103
Waste	293	328	362	362
2021 LRDP Demolition	44	44	44	0
2021 LRDP Construction	1,055	1,055	1,055	0
Interim Project Construction	1,820	0	0	0
Interim Project Operation	3,717	10,631	9,463	7,128
Total Scope 3 Emissions	**49,034**	**62,081**	**62,928**	**62,697**
Total Emissions	**172,425**	**232,446**	**279,931**	**279,700**

[1.] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for informational purposes and is utilized for developing a trajectory post-2035 to allow for UCR 2035 target setting.

Scope 1 Emissions BAU Forecast

Under the BAU forecast scenario, Scope 1 emissions are projected to continue increasing through 2035 as shown in Table 14. This increase is driven by an increase in natural gas and vehicle fleet fuel usage. 2035 Scope 1 emissions are projected to be 60,683 MT CO_2e under the business-as-usual scenario.

Scope 2 Emissions BAU Forecast

Under the BAU forecast scenario, Scope 2 emissions are projected to continue increasing through 2035 as shown in Table 14. This increase is driven by an increase in electricity usage. 2035 Scope 2 emissions are projected to be 156,320 MT CO_2e under the business-as-usual scenario.

Scope 3 Emissions BAU Forecast

Under the BAU forecast scenario, Scope 3 emissions are projected to continue increasing through 2035 as shown in Table 14. This increase is driven by emissions associated with on-site transportation by campus commuters and operation of projects defined as "Interim Projects". 2035 Scope 3 emissions are projected to be 62,928 MT CO_2e under the business-as-usual scenario.

3.3 Adjusted Forecast Scenario Calculation Results

Existing State polices and regulations will lead to a reduction from the BAU forecast of 180,905 MT CO_2e in GHG emissions by 2045 for UCR, as shown in Table 15. The increasing decarbonization of the electricity supply due to SB 100 and the Renewable Portfolio Standard (RPS) is the largest single factor contributing to GHG emissions reductions, with a reduction of 140,652 MT CO_2e by 2045 compared with the BAU forecast.

Table 15 Summary of State Legislative Reductions

Legislation	2025 (MT CO_2e reduced)	2030 (MT CO_2e reduced)	2035 (MT CO_2e reduced)	2045[1] (MT CO_2e reduced)
Senate Bill 100	18,660	42,916	82,948	140,652
Title 24	6,532	13,064	19,595	19,595
Tailpipe	6,466	12,865	15,856	19,555
Innovative Clean Transit	284	544	852	1,103
Total	**31,941**	**69,388**	**119,252**	**180,905**

[1] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for informational purposes and is utilized for developing a trajectory post-2035 to allow for UCR 2035 target setting.

Under the forecast scenario adjusted for reductions that will occur due to State and federal regulations, UCR GHG emissions are projected to decrease below 2018 emissions by 2045 assuming no additional growth post-2035 beyond that anticipated by the 2021 LRDP, as shown in

Table 16. The decrease that occurs between 2030 and 2045 is primarily driven by decarbonization of the electricity supply association with SB 100 and the Renewable Portfolio Standard. Under the forecast scenario adjusted for reductions that will occur due to State and federal regulations, 2035 emissions are projected to be 155,029 MT CO_2e, approximately 159 percent higher than the 2018 emissions level of 97,333 MT CO_2e.

Table 16 Adjusted Future GHG Forecast Scenario by Scope and Target Year

Scope	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2045[1] (MT CO_2e)
Scope 1				
Natural Gas	32,526	43,056	53,702	53,702
Other Fuels	138	178	218	218
Building and Facility Refrigerants	569	734	899	899
UCR Fleet (Unleaded)	1,440	1,611	1,782	1,782
UCR Fleet (Diesel)	35	39	44	44
UCR Fleet (CNG)	90	101	112	112
Total Scope 1 Emissions	**34,798**	**45,719**	**56,756**	**56,756**
Scope 2				
Electricity	64,510	68,666	57,703	0
Total Scope 2 Emissions	**64,510**	**68,666**	**57,703**	**0**
Scope 3				
UCR Business Travel	1,943	2,215	2,487	2,487
On-Road Transportation (Passenger)	29,684	30,324	29,423	28,757
On-Road Transportation (Commercial/Heavy Duty)	3,121	3,624	3,135	3,305
Public Transit	608	453	251	0
Waste	293	328	362	362
2021 LRDP Demolition	44	44	44	0
2021 LRDP Construction	1,055	1,055	1,055	0
Interim Project Construction	1,820	0	0	0
Interim Project Operation	2,905	6,697	3,814	-1,701
Total Scope 3 Emissions	**41,471**	**44,738**	**40,570**	**33,210**
Total Emissions	**139,920**	**159,124**	**155,029**	**89,966**

[1] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for information purposes and is utilized for developing a trajectory post-2035 to allow for 2035 target setting.

Scope 1 Emissions Adjusted Forecast

Under the State Legislative Reductions adjusted forecast scenario, Scope 1 emissions are projected to continue increasing through 2035 as shown in Table 16. This increase is driven by an increase in natural gas and vehicle fleet fuel usage. 2035 Scope 1 emissions are projected to be 56,756 MT CO_2e under the Legislative Reductions forecast scenario

Scope 2 Emissions Adjusted Forecast

Under the State Legislative Reductions adjusted forecast scenario, Scope 2 emissions are projected to increase through 2030 to 68,666 MT CO_2e and then begin to decrease through 2035 to 57,703 MT CO_2e as shown in Table 16. The trend is primarily driven by increased decarbonization of the electricity supply between 2035 and 2045 in association with SB 100 and the Renewable Portfolio Standard.

Scope 3 Emissions Adjusted Forecast

Under the State Legislative adjusted forecast scenario, Scope 3 emissions are projected to peak in 2030 at 44,738 MT CO_2e and then begin to decrease in 2035 as shown in Table 16. This trend is driven by a decrease in operational emissions associated with the interim projects through 2035 as electricity energy intensity factors decrease due to SB100.

3.4 Summary of BAU and Adjusted Forecasts Results

Table 17 provides the summary of BAU and adjusted forecast calculation results. Figure 5 shows the overall BAU and adjusted forecast results and in comparison to baseline.

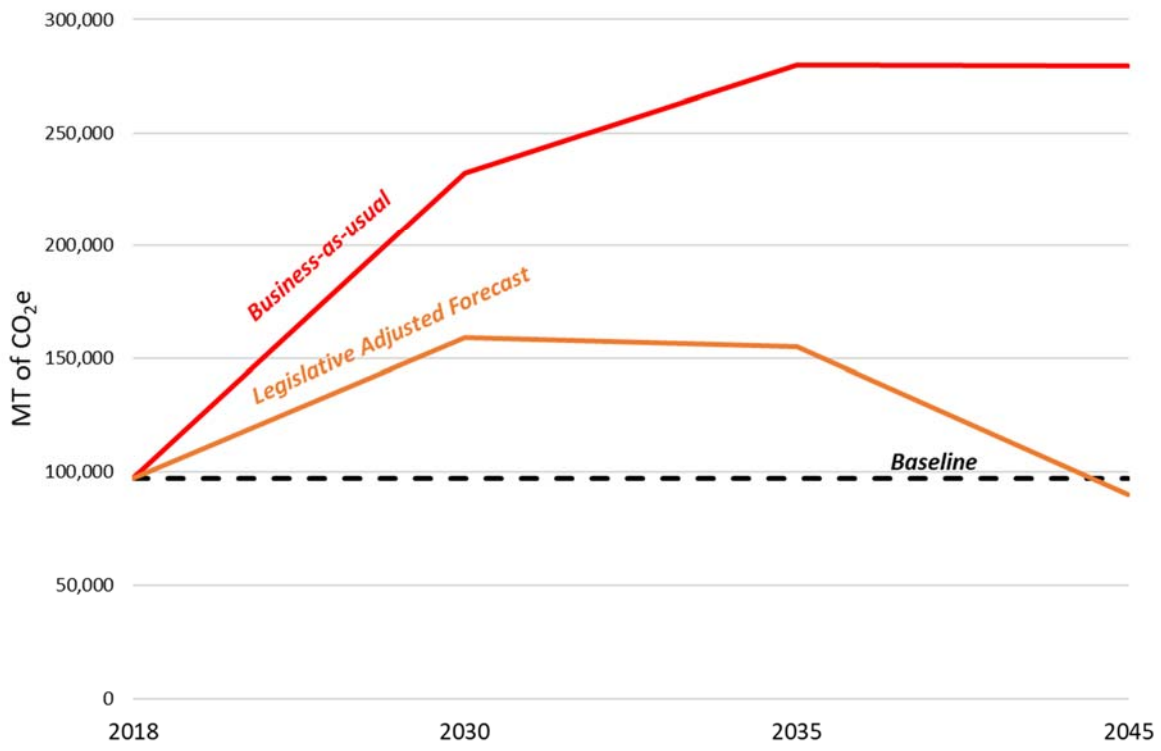
Table 17 Summary of BAU and Adjusted Forecasts by Year

Emissions Forecast	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2045[2] (MT CO_2e)
Baseline[1]	97,333	97,333	97,333	97,333
BAU Forecast	173,534	232,446	279,931	279,700
Adjusted Forecast	140,779	159,124	155,029	89,966

[1] Baseline emissions presented in the forecast include the construction emissions associated with interim projects that were constructed between 2018 and 2020 (97,232 MT CO_2e form the baseline inventory + 101 MT CO_2e from interim projects).

[2] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for information purposes and is utilized for developing a trajectory post-2035 to allow for UCR 2035 target setting.

Figure 5 Summary of BAU and Adjusted Forecasts by Year



4 2025, 2030, & 2035 GHG Emissions Targets

4.1 Target Types and Gap Analysis Methodology

Climate action plan GHG-reduction targets can be set as either an efficiency target (MT CO_2e per service population or per service population per year) or as a mass emissions target (total MT CO_2e). Throughout this section, targets are discussed in terms of mass emissions reduction, since the majority of the UCR Scope 1 and Scope 2 emissions are directly under UCR operational control and are tracked as mass emissions.

At this time, the State has codified a goal of reducing emissions to 40 percent below 1990 emissions levels by 2030 (SB 32) and has developed a Scoping Plan to demonstrate how the State will achieve the 2030 goal and make substantial progress toward the State's long-term GHG reduction goals. While no State plan currently exists to achieve carbon neutrality by 2045, EO B-55-18 directs CARB to ensure future Scoping Plan updates identify and recommend measures to achieve the carbon neutrality goal. Executive Orders are binding only unto State agencies. In addition, showing progress toward this goal is expected to be a mandatory component of CEQA analyses upon publication of the next Scoping Plan.

Based on this information and the nature of the 2021 LRDP, targets are established for the years 2025 (UC Policy target year), 2030 (SB 32 target year), and 2035 (2021 LRDP horizon target year). The 2035 target is intended to demonstrate UCR's commitment to achieving the long-term goal presented in EO B-55-18. This section provides UCR GHG targets for 2025, 2030, and 2035 that are in line with State targets.

Targets Baseline Year

UCR has been tracking progress under the UCOP Annual Reports. UCR has utilized the 1990 GHG emissions levels discussed in Section 1.3, *Previous Inventories 1990 GHG Emissions*, for establishing targets that align with the Statewide 2020 targets established by AB 32.[85] Therefore, the 1990 GHG emissions levels are also used to establish a 2030 target that aligns with the Statewide goal of SB 32 to reduce emission by 40 percent from the 1990 levels by 2030. However, because the previous inventories are based on campus-wide operations that include both the 2021 LRDP facilities as well as additional satellite facilities the 1990 baseline levels were scaled down to be more representative of just the 2021 LRDP boundary. UCR provided dis-aggregated activity data for Scope 1 and Scope 2 emission sources for 2018 calendar year such that only activity data under the 2021 LRDP operational boundary were included. It was not possible to disaggregate 2018 data from Scope 3 sources in the same way. Additionally, as described in Section 2.4, some sources of Scope 3 emissions in this inventory for the 2021 LRDP have not been previously included in the annual inventories prepared by CCWG, including emissions associated with transit and waste generation. Therefore, it would not be appropriate to include transit and waste generation Scope 3 emissions data sources for scaling purposes.

A comparison between the UCR-wide inventory to the 2021 LRDP (i.e., main campus) inventory including just emission sources included in the CCWG reports showed that the 2021 LRDP operational boundary accounts for approximately 90 percent of campus-wide emissions (e.g., 2021

[85] UCR. 2020. GHG Reporting Tool Fiscal Year 2018/2019 prepared by the UCR Climate Change Working Group.

LRDP inventory/UCR-wide inventory where 93,791/104,767 = 90 percent)[59]. Therefore, for the purposes of establishing a 1990 baseline consistent with the UCR-established baseline for tracking in the Annual Report, it was conservatively estimated that, for the 2021 LRDP boundary area, 1990 levels would have been approximately 73,559 MT CO_2e.

Proposed UCR Targets for 2025, 2030, and 2035

The UC Policy Carbon Neutral by 2025 goal recognizes that UC has already established aggressive emissions reduction goals and has begun working towards them. Consistent with the goals established by the UC Policy, the proposed UCR targets would achieve carbon neutrality for Scope 1 and Scope 2 emissions by 2025 and continue to reduce GHG emissions in a linear fashion until reaching carbon neutrality for Scope 1, 2, and 3 emissions by 2045 (consistent with EO B-55-18). Table 18 includes the proposed UCR targets and related emissions gaps for 2025, 2030, and 2035.

Table 18 UCR Targets by Year and Related Emissions Gaps

Year	Adjusted Forecasts (MT CO_2e)	Proposed UCR Targets (MT CO_2e)	Emissions Gaps to Target (MT CO_2e)
2025	139,920	41,471	98,448
2030	159,124	31,104	128,020
2035	155,029	20,736	134,294

Comparison of State Targets and Proposed UCR Targets

Both the UC 2020 goal (per UC Policy) and the State 2020 target (per AB 32) entail reaching 1990 GHG emissions levels by 2020. To align with the State 2030 target (per SB 32), the UCR main campus, representative of the 2021 LRDP area, would need to reduce GHG emissions 40 percent below 1990 levels representative of and scaled to the main campus (i.e., 40 percent below 73,559 MT CO_2e as detailed above in *Targets Baseline Year*). Based on the scaled main campus 1990 levels, the 2020 State target would be 73,559 MT CO_2e and the 2030 State target would be 31,104 MT CO_2e as shown in Table 19. A linear interpolation between the 2020 and 2030 State targets indicates that a 2025 target would need to be approximately 58,847 MT CO_2e to be aligned with SB 32. However, to align with the UC 2025 goal (per UC Policy) of reaching carbon neutrality related to Scope 1 and Scope 2 emissions, the 2025 UCR target would be 41,471 MT CO_2e. As shown in Table 19, this 2025 UCR target would be 17,376 MT CO_2e (or approximately 30 percent) less than the level that would need to be reached in 2025 to be aligned with SB 32. As such, the UC 2025 goal is more stringent than the State 2030 target.

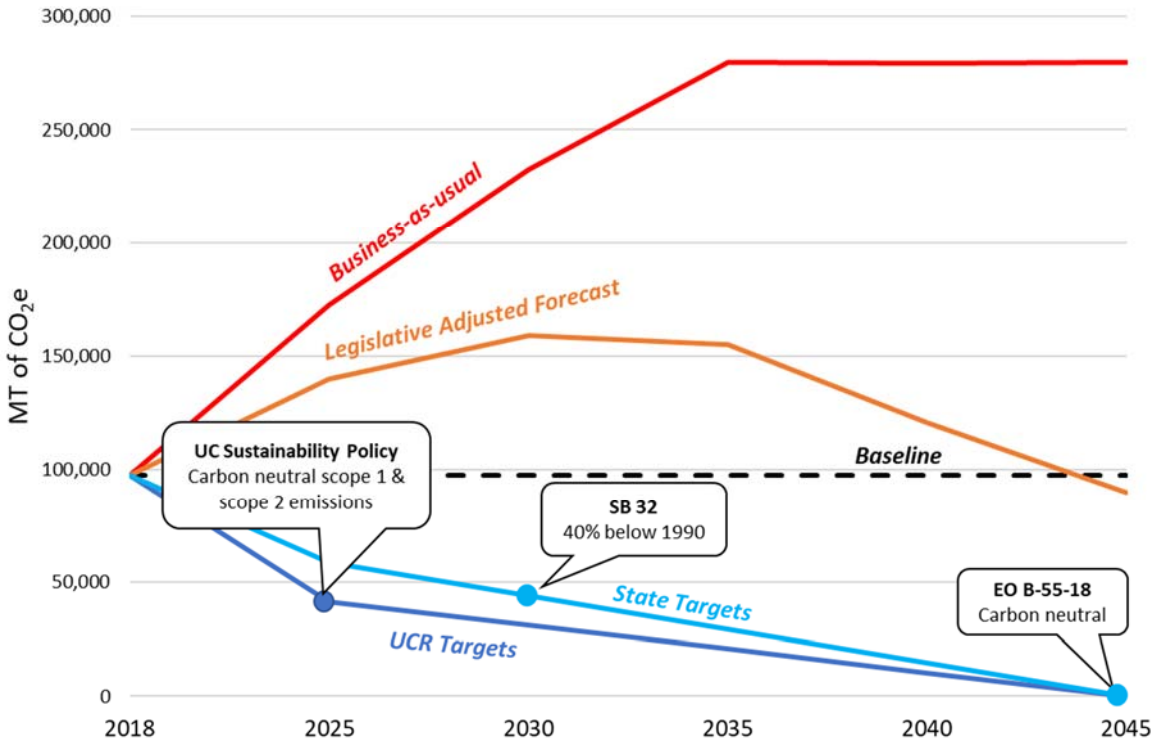
The UC Policy also includes a goal of reaching carbon neutrality related to Scope 3 emissions by 2050 or sooner. As outlined in the EO B-55-18, the State goal is to reach carbon neutrality by 2045. Meeting the State target of carbon neutrality by 2045 would be aligned with the UC Policy goal to reach carbon neutrality related to Scope 3 emissions by 2050 or sooner. While the UCR forecasts and target setting will need to be revised and updated for post-2035 to accommodate a future LRDP update, aligning the UCR 2035 target with the State 2045 carbon neutrality target trajectory would ensure UCR is aligned both with State future-year targets and UCR future-year targets. As such, Table 19 and Figure 6 show a linear interpolation between the UC 2025 goal and the State 2045 carbon neutrality goal. As shown, by first meeting the UC 2025 goal, UCR would be on a pathway that aligns with UC Policy and is also more stringent than State targets through the 2021 LRDP horizon year of 2035. As such, it is recommended that UCR utilize the UC 2025 goal as its initial

target and then follow a linear trajectory between 2025 and 2045 to meet carbon neutrality in 2045 in order to align UCR with both State and UC goals in 2030 and 2035.

Table 19 Difference in State Targets and Proposed UCR Targets

Year	State Targets (MT CO_2e)	Proposed UCR Targets (MT CO_2e)	Difference in Targets (MT CO_2e)
2025	58,847	41,471	17,376
2030	44,135	31,104	13,032
2035	29,424	20,736	8,688

Figure 6 Summary of State Targets and Established UC Policy Targets



4.2 Summary of Emissions Reduction Targets Results

The State currently has goals for reducing GHG emissions by 40 percent compared to 1990 levels by 2030 (per SB 32) and achieving carbon neutrality by 2045 (per EO B-55-18). It is recommended that UCR GHG emissions targets are established for the years 2025 (UC Policy target year), 2030 (SB 32 target year), and 2035 (2021 LRDP horizon target year) to show compliance with these multiple-year UC and State goals and establish substantial progress toward the State 2045 carbon neutrality goal.

The UCR targets are based on a total GHG emissions (i.e., mass emissions) metric. The UCR targets would follow a two-part trajectory. The first part of the trajectory would be a steep reduction in GHG emissions between 2020 and 2025 to achieve carbon neutrality related to Scope 1 and Scope 2 emissions. Following 2025, the second part of the trajectory would continue to decrease in a linear fashion, until reaching carbon neutrality for Scope 1, 2, and 3 emissions by 2045.

Table 20 provides total UCR 2025, 2030, 2035 and 2045 GHG emissions, and Figure 7 shows these mass emissions reduction targets in relation to baseline, BAU forecast, and adjusted forecast for the purpose of UCR 2035 target setting.

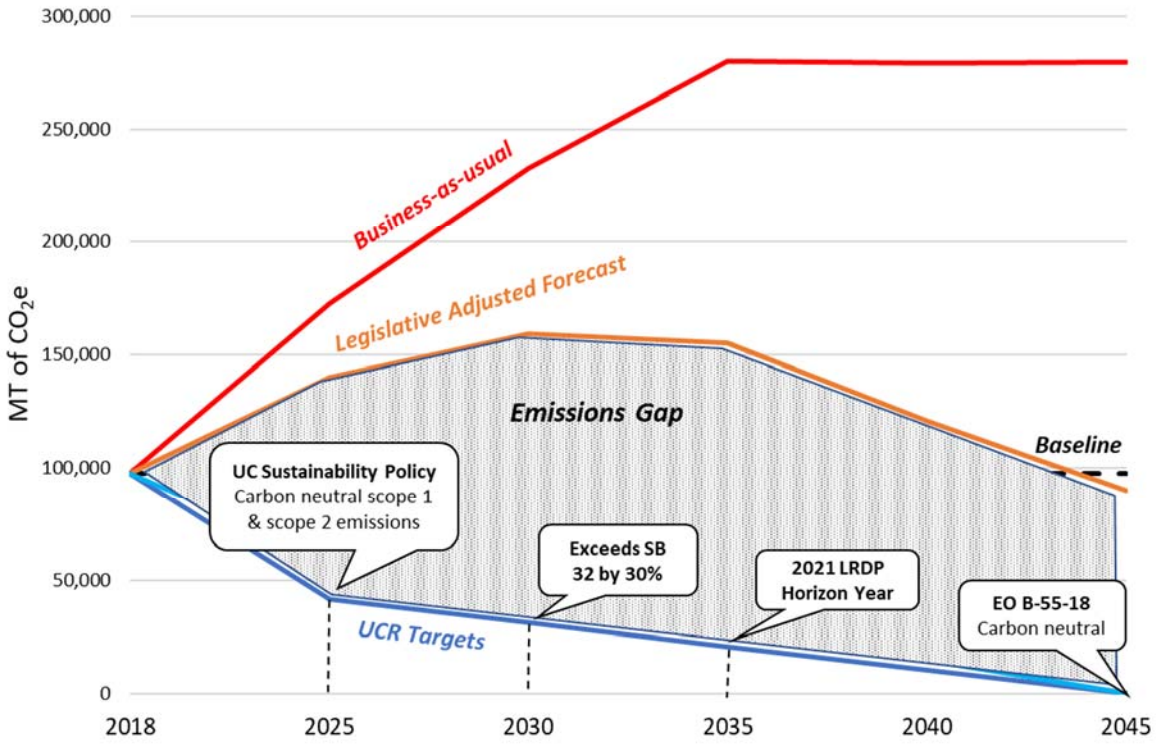
Table 20 UCR Targets Compared to Future GHG Emissions Forecasts

Emissions Forecast	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2045[2] (MT CO_2e)
Baseline Emissions Forecast	73,559	73,559	73,559	73,559
BAU Emissions Forecast	172,425	232,446	279,931	279,700
Adjusted Emissions Forecast	139,920	159,124	155,029	89,966
Proposed UCR Targets	41,471	31,104	20,736	0[2]

[1] SB 32 Target shown for informational purposes only.

[2.] As noted in Section 3.1, *Forecast Data and Methodology: Forecast Years (2025, 2030, and 2035)*, 2045 forecast data is provided for informational purposes and is utilized for developing a trajectory post-2035 to allow for UCR 2035 target setting.

Figure 7 Proposed UCR Targets Compared to Future GHG Emissions Forecasts



Meeting the GHG Emissions Targets

The GHG emissions targets identified above will be achieved through implementation of GHG emissions reduction measures identified in the UCR GHGRS associated with the 2021 LRDP.

5 Conclusion

State regulations in addition to UC policies are expected to achieve State 2030 GHG emissions targets as well as continue to reduce emissions to carbon neutrality by 2045. However, proposed UCR targets for 2025, 2030, and 2035 require additional emissions reductions from measures included in the 2021 GHGRS. UCR would adopt the UCR targets discussed above in Section 4, *2025, 2030, and 2035 GHG Emissions Targets* as part of the 2021 LRDP, as these targets are in compliance with UC Policy emissions reduction goals and State emissions reduction goals.

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Appendix A

Inventory, Forecast, and Targets Modeling Outputs

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2018 UCR GHG Emission Inventory

General Information

GWP (ARS)	
CH4	28
N2O	265

1. The GWP values are 100-year values from the Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (ARS) 2013.

Scope 1

Stationary Combustion

Natural Gas (Buildings and Facilities)

Data Source [1]	*Natural Gas Usage*		*Emission Factors* [3]			*Emissions* [4]			CO_2e *(MT)* [5]	*Sum* CO_2e *(MT)*
	Usage (Therms)	*Usage (MMBtu)* [2]	*kg* CO_2*/MMBtu*	*kg* CH_4*/MMBtu*	*kg* N_2O*/MMBtu*	CO_2 *(MT)*	CH_4 *(MT)*	N_2O *(MT)*		
Annual Utility Data (SCG)	3,471,747	347,091	53.06	0.001	0.0001	18416.670	0.347	0.035	18,435.59	18,410.07
Annual Utility Data (Shell)	3,466,942	346,611	53.06	0.001	0.0001	18391.180	0.347	0.035	18,410.07	

Notes:

1. A summary of the SCG and Shell invoices was provided by UCR Energy Manager
2. Converted to MMBtu for emission calc (1 MMBtu = 10.0024 Therms)
3. Emission factors obtained from TCR (April 2020) for natural gas in industrial uses: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf
4. Conversion: 1,000 kg = 1 MT
5. Utility data reported from SCG and Shell are not different sources of natural gas being provided to the campus, rather two reports of the same quantity used on campus. To provide a conservative estimate the recorded quantity with the highest emissions was utilized in the inventory.

Energy Manager will provide rationale regarding using the Shell natural gas data.

Other Stationary Combustion (Buildings and Facilities)

Fuel Type	*Data Source* [1]	*Fuel Usage (gallons)*	*Emission Factors* [2,3]			*Emissions* [4]			CO_2e *(MT)*	*Sum* CO_2e *(MT)*
			kg CO_2*/gallons*	*kg* CH_4*/gallons*	*kg* N_2O*/gallons*	CO_2 *(MT)*	CH_4 *(MT)*	N_2O *(MT)*		
Diesel #2	Invoice Summary	8,003	10.21	0.00041	0.00008	81.711	0.003	0.001	81.97	81.97216804
Propane	Invoice Summary	-	5.72	0.00027	0.00005	0.000	0.000	0.000	-	

Notes:

1. A summary of the fuel usage for Diesel #2 was provided by the UCR Campus Planning Department in a fuel use summary spreadsheet based on a summary of invoices to UCR.
2. Emission factors obtained from TCR (April 2020) for CO2, and EPA 2018 Emission Factors for CH4, N2O
3. Conversions: 1,000 kg = 1 MT and 1,000,000 g = 1 MT

Fugitive Emissions

Data Source [1]	*Refrigerant*	*CAS Number*	*Added*		*Trace Gas Used*		*Disposed Appliance Losses*		*Recovered*		*Startup Chg.*		*Net Refrigerant Emissions (lbs.)* [2]	*Global Warming Potentials (GWP)* [3]	CO_2e *(MT)* [4]	*Sum* CO_2e *(MT)*
			(lbs.)	*(oz)*	*(lbs.)*	*(oz)*	*(lbs.)*	*(oz)*	*(lbs.)*	*(oz)*	*(lbs.)*	*(oz)*				
UCR Refrigerants	R-11	75-69-4	0	0	0	0	0	0	0	0	0	0	0	4,660	0	339
	R-12	75-71-8	0	0	0	0	0	0	0	0	0	0	0	10,200	0	
	CFC-113	76-13-1	0	0	0	0	0	0	0	0	0	0	0	13,900	0	
	R-22	75-45-6	212	6.25	0	0	0	0	49	11.5	0	0	162.67	1,760	129.86	
	R-502	75-45-6 (48.8%), 76-15-3 (51.2%)	0	0	0	0	0	0	0	0	0	0	0	4656.7	0	
	R-123	306-83-2	0	0	0	0	0	0	0	0	0	0	0	79	0	
	R-134A	811-97-2	31	5.25	0	0	0	0	14	5.5	0	0	16.98	1,120	8.63	
	R-404A	420-46-2	208	11.25	0	0	0	0	111	3	10	11.75	86.78	3,943	155.21	
	R-407C[2]	354-33-6	79	13.25	0	0	0	0	8	2	0	0	71.70	1,624	52.82	
	R-410A	75-10-5	104	15.25	0	0	0	0	53	8	0	0	51.45	1,924	44.90	

Notes:

1. A "Usage Summary Report" of refrigerants was provided by UCR Campus Planning Department; the Sustainability Officer disaggregated the data -> just main campus data is represented here
2. Refrigerant added and recovered outside the LRDP boundary was excluded from the estimate. Sustainability Officer indicated entries outside of LRDP boundary in "Refrigerant Usage by Refrigerant Type" document dated 4/6/2020.
3. GWPs for refrigerants R-134A, R-404A, R-407C, and R-410A obtained from TCR (AR5 factors); R-11, R-12, CFC-113, R-22, and R-123 obtained Greenhouse Gas Protocol (AR5) (https://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf); R-502 obtained from CARB (AR4) (https://ww2.arb.ca.gov/resources/documents/high-gwp-refrigerants)
4. Conversion: 2204.62 lbs. = 1MT

Mobile Combustion

CO_2 Emissions from Mobile Combustion[1]

Fuel Type [3]	*Consumption (gallons)* [2]	*Emission Factors* [4]		*kg* CO_2	*MT* CO_2 [5]	*Sum* CO_2e *MT*
		kg CO_2*/gallon*	*kg* CO_2*/SCF*			
Unleaded Gasoline	135,192	8.78		1186985.76	1186.98576	
CNG	4,321		0.054444	29070.15439	29.07015439	1305.040462
Diesel	7,306	10.21		74594.26	74.59426	

Notes:

1. ICLEI Local Government Protocol Method 7.1.1 used to determine fleet CO2 emissions
2. Annual fuel consumption based on "Key Fleet Indicators 2008-2019" spreadsheet provided by UCR's Office of Sustainability
3. CNG fuel consumption is expressed as gallon equivalents. For emissions calculations CNG fuel consumption is converted to scf where 123.57 scf CNG = 1 gasoline equivalent gallons and there are 1027 BTUs/ standard cubic foot (SCF); emission factors from TCR v.2.1 (2016) Table 13.6.
4. Emission factors obtained from TCR (April 2020) for mobile combustion: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf
5. 1000 kg = 1 Metric Ton

CH_4 and N_2O Emissions from Mobile Combustion[1]

Vehicle Class [2]	*Number of Units*	*Average MPG* [3,4]	*Fuel Type*	*Fuel Quantity*	*Attribution by Fuel & Vehicle class* [5]			*Emission Factors* [6]				*g* CH_4	*g* N_2O	*MT CO2e*	*SUM MT CO2e*
					% of Total Units by Fuel	*Estimated Fuel use by Vehicle Class (gallons)*	*Estimated Mileage*	CH_4 *(g/mile)*	N_2O *(g/mile)*	CH_4 *(g/gallon)*	N_2O *(g/ gallon)*				
MCY	*3*	*38.40*	*Gasoline*		*0.5%*	*637.6981132*	*24487.75155*	*0.067*	*0.007*			*1645.576904*	*168.9654857*	*0.090852007*	
LDA	*144*	*28.91*	*Gasoline*		*22.6%*	*30609.50943*	*884898.4832*	*0.008*	*0.011*			*7076.854446*	*10022.82203*	*2.854199763*	
LDT1	*168*	*24.45*	*Gasoline*		*26.4%*	*35711.09434*	*873051.1711*	*0.010*	*0.013*			*8560.785826*	*11610.86417*	*3.316581009*	
LDT2	*91*	*22.29*	*Gasoline*		*14.3%*	*19343.50943*	*431175.008*	*0.010*	*0.013*			*4227.927318*	*5734.273795*	*1.63796452*	
LHD1	*6*	*10.43*	*Gasoline*		*0.9%*	*1275.396226*	*13300.57193*	*0.019*	*0.031*			*247.410772*	*408.5166841*	*0.115184423*	
LHD2	*54*	*9.10*	*Gasoline*		*8.5%*	*11478.56604*	*104480.4132*	*0.019*	*0.031*			*1943.493846*	*3209.034332*	*0.904811926*	
MDV	*77*	*18.30*	*Gasoline*		*12.1%*	*16367.58491*	*299512.465*	*0.019*	*0.031*			*5571.385246*	*9199.291559*	*2.59381105*	
BUS	*2*	*5.82*	*Gasoline*	*135,192*	*0.3%*	*425.1320755*	*2474.450147*	*0.019*	*0.031*			*46.0285185*	*76.00080465*	*0.021429012*	
OFFROAD	*13*		*Gasoline*		*2.0%*	*2763.358491*	*N/A*			*9.119*	*0.136*	*25199.17236*	*376.1356038*	*0.805252761*	
LDA	*12*	*22.55*	*Flex Fuel*		*1.9%*	*2550.792453*	*57518.40141*	*0.008*	*0.007*			*460.1472113*	*402.6288099*	*0.119580757*	
LDT1	*2*	*19.07*	*Flex Fuel*		*0.3%*	*425.1320755*	*8106.903732*	*0.013*	*0.014*			*105.3897485*	*113.4966522*	*0.033027526*	
LDT2	*26*	*17.39*	*Flex Fuel*		*4.1%*	*5526.716981*	*96090.43035*	*0.013*	*0.014*			*1249.175595*	*1345.266025*	*0.391472413*	
LHD1	*1*	*8.13*	*Flex Fuel*		*0.2%*	*212.5660377*	*1729.07435*	*0.075*	*0.028*			*129.6805763*	*48.41408181*	*0.016460788*	*14.39028744*
LHD2	*3*	*7.10*	*Flex Fuel*		*0.5%*	*637.6981132*	*4527.484572*	*0.075*	*0.028*			*339.5613429*	*126.7695568*	*0.043101653*	
MDV	*34*	*14.27*	*Flex Fuel*		*5.3%*	*7227.245283*	*103156.7607*	*0.013*	*0.014*			*1341.037889*	*1444.19465*	*0.420260643*	
LDA	*1*	*47.36*	*Diesel*		*2.7%*	*197.4594595*	*9351.351284*	*0.001*	*0.001*			*4.675675642*	*9.351351284*	*0.002609027*	
LDT1	*1*	*24.99*	*Diesel*		*2.7%*	*197.4594595*	*4934.560873*	*0.001*	*0.002*			*4.934560873*	*7.40184131*	*0.002099656*	
LDT2	*6*	*34.60*	*Diesel*	*7,306*	*16.2%*	*1184.756757*	*40987.78762*	*0.001*	*0.002*			*40.98778762*	*61.48168143*	*0.017440304*	
LHD2	*17*	*18.48*	*Diesel*		*45.9%*	*3356.810811*	*62039.88415*	*0.005*	*0.005*			*316.4034092*	*297.7914439*	*0.087774028*	
BUS	*8*	*8.92*	*Diesel*		*21.6%*	*1579.675676*	*14090.77172*	*0.005*	*0.005*			*71.86293579*	*67.63570427*	*0.019935624*	
OFFROAD	*4*		*Diesel*		*10.8%*	*789.8378378*	*N/A*			*0.284*	*0.485*	*224.3139459*	*383.0713514*	*0.107794699*	
LDA	*10*	*0.23*	*CNG*		*35.7%*	*1543.214286*	*361.0358011*	*0.085*	*0.007*			*30.68804309*	*2.527250607*	*0.001528987*	
LDT2	*8*	*0.18*	*CNG*	*4,321*	*28.6%*	*1234.571429*	*222.7006506*	*0.126*	*0.014*			*28.06028197*	*3.117809108*	*0.001611907*	
LHD2	*6*	*0.07*	*CNG*		*21.4%*	*925.9285714*	*68.20428854*	*3.700*	*0.001*			*252.3558676*	*0.068204289*	*0.007084038*	
BUS	*4*	*4.50*	*CNG*		*14.3%*	*617.2857143*	*2777.438927*	*10.000*	*0.001*			*27774.38927*	*2.777438927*	*0.778418921*	
TOTAL						*146819*	*1009657*								

Notes:

1. Only bulk fuel purchase data and a fleet list (including model years and vin numbers) were provided, therefore emissions were estimated using the alternative method 7.1.3.2.1. Hybrid vehicles and gasoline vehicles combined.
2. Vehicle class and fuel type was determined by using the provided vehicle data.
3. MPG was for each vehicle class and fuel type based on EMFAC 2017 (SC) for Riverside County except for vehicles powered by CNG and flex fuel in which MPG is based on GGE. 5.66 lbs. or 123.57 scf CNG = 1 GGE; 1 gallon of E85 (flex fuel) has on average 78% the energy of one gallon of gasoline
4. CNG is in scf instead of gallons.
5. Bulk fuel purchase data was provided, therefore fuel consumption was allocated across vehicle types in proportion to the number of vehicles using each fuel type. Annual mileage was estimated based on fuel consumption and average MPG for each fuel type and vehicle class; although actual mileage was provided it was in bulk and not by fuel.

6. TCR's 2020 emission factors for vehicles by fuel type and model year from Table 2.5 were averaged (weighted) for each vehicle class based on number of miles per vehicles model year. Emission factors for off-road equipment are from Table 2.7; weighted average based on number of units and equipment classification where EQ (tractor, spray rig) = agricultural equipment, ATV = recreational equipment, BO = boat, and GEN = generator; emission factors used average between 2-stroke and 4-stroke engine.

Class ID	*Description* [1]	*EMFAC Characterization*	*MPG*	*Number of Units*	*Unit*	*Number of Units*	*Units*	*Number of Units*	*Units*	*Number of Units*	*Units*	*Number of Units*	*Units*	
MO	NA	MCY		-	CNG	-	Diesel	3	Gasoline		Flex Fuel		Hybrid	
CS	Compact Sedan	LDA		10	CNG	-	Diesel	52	Gasoline	3	Flex Fuel	22	Hybrid	
CS-E	Compact Sedan - Enterprise	LDA		-	CNG	-	Diesel	3	Gasoline		Flex Fuel		Hybrid	
EC	Electric Carts/Gems	LDA		-	CNG	-	Diesel	3	Gasoline		Flex Fuel		Hybrid	
EXE	Executive Vehicles	LDA									Flex Fuel		Hybrid	
LS	Large Sedans	LDA		-	CNG	-	Diesel	5	Gasoline	1	Flex Fuel		Hybrid	
LW	Suburban/Expedition 2X4	LDA		-	CNG	-	Diesel	18	Gasoline	4	Flex Fuel		Hybrid	
PV	Police Vehicles	LDA		-	CNG	-	Diesel	15	Gasoline	4	Flex Fuel		Hybrid	
SW	Small Wagon - Trailblazer	LDA		-	CNG	1	Diesel	5	Gasoline		Flex Fuel		Hybrid	
UV	Utility Vehicle - 8 Passenger Club Car	LDA		-	CNG	-	Diesel	19	Gasoline		Flex Fuel		Hybrid	
WD-EXPLR	NA	LDA		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
CT	Compact Truck	LDT1		-	CNG	-	Diesel	126	Gasoline	1	Flex Fuel		Hybrid	
CT-E	Compact Truck - Enterprise	LDT1		-	CNG	-	Diesel	8	Gasoline		Flex Fuel		Hybrid	
CV	Cargo Van - 12 Passenger Van No Seat	LDT1		-	CNG	1	Diesel	30	Gasoline		Flex Fuel		Hybrid	
CW	Compact Wagons	LDT1		-	CNG	-	Diesel	4	Gasoline	1	Flex Fuel		Hybrid	
MT	Medium Size Trucks	LDT2		5	CNG	6	Diesel	55	Gasoline	10	Flex Fuel		Hybrid	
ST	Standard Truck	LDT2		3	CNG	-	Diesel	34	Gasoline	16	Flex Fuel		Hybrid	
ST-E	Standard Truck - Enterprise	LDT2		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
FS	Full Size Trucks	LHD1		-	CNG	-	Diesel	6	Gasoline	1	Flex Fuel		Hybrid	
HT	Heavy Trucks	LHD2		6	CNG	17	Diesel	37	Gasoline		Flex Fuel		Hybrid	
HTB	Heavy Duty Box Truck	LHD2		-	CNG	-	Diesel	12	Gasoline		Flex Fuel		Hybrid	
HTS	Heavy Trucks - Stakebed	LHD2		-	CNG	-	Diesel	5	Gasoline	3	Flex Fuel		Hybrid	
MP	Multi Passenger Van	MDV		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
MP11	Multi Passenger Van - 11 Passenger	MDV		-	CNG	-	Diesel	4	Gasoline		Flex Fuel		Hybrid	
MP12	Multi Passenger Van - 12 Passenger	MDV		-	CNG	-	Diesel	32	Gasoline	10	Flex Fuel		Hybrid	
MP8	Multi Passenger Van - 8 Passenger	MDV		-	CNG	-	Diesel	4	Gasoline		Flex Fuel		Hybrid	
MV	Minivan	MDV		-	CNG	-	Diesel	17	Gasoline	22	Flex Fuel		Hybrid	
MV-E	Minivan - Enterprise	MDV		-		-		-			Flex Fuel		Hybrid	
OVR	Outside Vehicle	MDV		-		-		-			Flex Fuel		Hybrid	
SUV	5 Passengers SUV	MDV		-	CNG	-	Diesel	3	Gasoline		Flex Fuel	5	Hybrid	
SUV-E	5 Passengers SUV - Enterprise	MDV		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
WD	Suburban/Expedition 4X4	MDV		-	CNG	-	Diesel	8	Gasoline	2	Flex Fuel		Hybrid	
BUS	NA[2]	BUS		4	CNG	8	Diesel	2	Gasoline		Flex Fuel		Hybrid	
EQ	NA	OFFROAD		-	CNG	2	Diesel	4	Gasoline		Flex Fuel		Hybrid	
TRLR	NA	OFFROAD		-	CNG	2	Diesel	-	Gasoline		Flex Fuel		Hybrid	
BO	NA	OFFROAD		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
ATV	NA	OFFROAD		-	CNG	-	Diesel	5	Gasoline		Flex Fuel		Hybrid	
GEN	NA	OFFROAD		-	CNG	-	Diesel	2	Gasoline		Flex Fuel		Hybrid	
		Total		28	CNG	37	Diesel	531	Gasoline	78	Flex Fuel	27	Hybrid	701

Notes:

1. Descriptions obtained from "Key Fleet Indicators 2008-2019" provided by Client
2. NA = Nothing Available
3. EQ = agricultural equipment (tractor, spray rig); TRLR = trailer; BO = boat

Scope 2

Electricity

Data Source [1]	*Utility* [2]	*Electricity Usage (kWh)*	*Emission Factors* [3] *MT CO_2e/Mwh*	*CO_2e (MT)* [4]	*Emission Sum CO_2e (MT)*
Annual Utilities Summary Spreadsheet 2015-2020	Riverside Public Utility (RPU)	107,088,200	0.428	45,833.75	45,833.75
	SunPower Lot 30 - SOLAR GENERATIO	5,733,909	0	-	
	SunPower Lot 32 - SOLAR GENERATIO	1,098,690	0	-	
	Solar - SunPower	5,039,876	0	-	

Notes:

1. A summary of the electricity purchased from RPU and generated by on-site solar was provided by UCR Energy Manager
3. UCR provided an emission factor of 0.4065 MT CO2e/MWh for RPU provided by Tracy Sato email correspondence. UCR Energy Manager provides emission factor of 0.428 MT CO2e/MWh
2. Conversion: 1 MT = 2204.62 lbs.

Scope 3

Business Travel

Air Travel

Data Source [1]	*Passenger Miles*	*Energy Intensity (BTU/passenger mile)* [2]	*MMBtu*	*Gallons* [3]	*Emission Factors* [3] *kg CO_2/gallon*	*kg CH_4/gallon*	*kg N_2O/gallon*	*Emissions* [4] *CO_2 (MT)*	*CH_4 (MT)*	*N_2O (MT)*	*Sum CO_2e (MT)* [5]
Balboa Carbon Emission Air Detail	8,273,344	2,654	21,957	182,979	8.31	0.007063	0.000107	1520.554	1.292	0.020	1561.928738

Notes:

1. UCR tracks UCR faculty/staff air travel through an invoice tracking system (Balboa Carbon Emission Air Detail). However, this does not include other faculty travel booked separately outside of Connexxus.
2. Energy intensity factor obtain from https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/Primer_Jan2015.pdf
3. Conversion factor for aviation gasoline is 0.120 MMBtu/gallon per TCR 2020
*average kg CO2/mile = 0.1844499 per UCR data provided

On-site Transportation

Mobile

Vehicle Type	*Trip Type (Daily VMT)* [1] *External-External*	*Internal-External*	*External-Internal*	*Internal-Internal*	*Accounted for UCR Cam*	*Annual VMT*	*% of Total VMT*	*% Fuel Use by Vehicle Category* [3] *% Gasoline*	*% Diesel*	*% Natural Gas*	*CO_2 (g/mile)* [4] *Gasoline EF*	*Diesel EF*	*Natural Gas EF*	*CH_4 (g/mile)* [4] *Gasoline EF*	*Diesel EF*	*Natural Gas EF*	*N_2O (g/mile)* [4] *Gasoline EF*	*Diesel EF*	*Natural Gas EF*	*Emissions* [5] *CO_2 (MT)*	*CH_4 (MT)*	*N_2O MT*	*CO_2e (MT) by Vehicle Type* [6]	*Sum CO_2e (MT)* [7]	Emission Factor (MT CO_2e/mile)	Emission Factor (g CO_2e/mile)
Passenger[2]	320,431,288	245,046	255,393	2,420	252639.5	79581442.5	97.5%	98.78%	0.84%		331.3962553	281.2887039		0.005454803	0.000850819		0.00396056	0.044214667		26239.20019	0.429361449	0.341017118	26342		0.000331002	331.0016886
Light Trucks	3,240,237	1,869	1,881	52	1927	607005	0.7%	44.59%	55.41%		821.2641268	513.6493167		0.008842543	0.004834858		0.0183738	0.08073852		395.0531914	0.004019587	0.032127739	404	28713.57818	0.000665035	665.0350336
Medium Trucks	5,401,191	1,823	1,835	3	1832	577080	0.7%	6.58%	93.42%		1679.051963	979.7309893		0.023059596	0.009423751		0.03872765	0.154000068		591.9179386	0.005955652	0.084496505	614		0.001064803	1064.802576
Heavy Trucks	16,466,030	2,839	2,851	1	2846	896490	1.1%	0.03%	99.66%	0.31%	2218.131977	1442.756916	3390.077554	0.174581754	0.007271212	5.578321069	0.20123362	0.226781296	0.691089486	1299.003686	0.021909751	0.204578527	1354		0.001510146	1510.145645

Notes:

1. RivTAM model used origin-destination method where assumptions for year 2018 were population = 6,511; employment = 4,739; households = 6,511; based on Caltrans Data Fehr & Peers recommends annualizing data based on 315 days/year for the study area. Origin-Destination Model includes 50% of trips from internal-external and external internal, 100% of internal-internal trips, and excludes external-external trips.
2. Passenger category includes EMFAC2007 categories LDA, LDT1, and LDT2; overall emission factor was calculated as a weighted average based on fuel type and vehicle class
3. The percent of fuel type by vehicle type was estimated based on EMFAC2017 for Riverside County (SC) data where VMT by fuel type is divided by total VMT for the specified category (i.e. passenger, light truck etc.)
4. Emission factors (running) obtained from EMFAC2017 where model years and speed were aggregated for each fuel type by vehicle class.
5. Conversion: 1,000 kg (or 1,000,000 g) = 1 MT
6. 100 year global warming potential (GWP) values pulled from Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5) 2013.
7. Calculated emissions are comparable to CCWG emissions reported for commuters based on survey (28,125 MT CO_2e in 2018)

Transit

TR.4 Emissions from Transit[1] (TR.4.A. & TR.4.B.)

Transit Agency	*Mode*	*Route*	*Annual Passengers*	*Annual VRMs*	*VRMs/Passenger*	*Operation Information* [2] *g CO2/mile*	*Emission Factors* [3] *g CH_4/mile*	*g N_2O/mile*	*g CO2e/mile*	*MT of Emissions* [4] *MT CO_2*	*MT CH_4*	*MT N_2O*	*CO_2e MT*	*SUM CO_2e MT* [5]
Riverside Transit Agency (RTA)	MB	Rapid Link Gold Line (101)	147001	240386	0.611520638	1680.300671	3.044856827	0.211646889	1821.643088	403.9207571	0.731940953	0.050876949	437.8974953	3537.159071
Riverside Transit Agency (RTA)	MB	1	1921643	868915	2.211543131	1680.300671	3.044856827	0.211646889	1821.643088	1460.038458	2.64572177	0.183903156	1582.853004	
Riverside Transit Agency (RTA)	MB	16	449937	362495	1.241222638	1680.300671	3.044856827	0.211646889	1821.643088	609.1005918	1.103745375	0.076720939	660.3365111	
Riverside Transit Agency (RTA)	MB	51	19070	32397	0.58863475	1680.300671	3.044856827	0.211646889	1821.643088	54.43670084	0.098644227	0.006856724	59.01577111	
Riverside Transit Agency (RTA)	MB	52	23762	42245	0.562480767	1680.300671	3.044856827	0.211646889	1821.643088	70.98430185	0.128629977	0.008941023	76.95531224	
Riverside Transit Agency (RTA)	MB	204	42999	133852	0.321242865	1680.300671	3.044856827	0.211646889	1821.643088	224.9116054	0.407560176	0.028329359	243.8305706	
Riverside Transit Agency (RTA)	MB	208	28036	186123	0.150631572	1680.300671	3.044856827	0.211646889	1821.643088	312.7426018	0.566717887	0.039392354	339.0496764	
Riverside Transit Agency (RTA)	MB	212	6585	75328	0.087417693	1680.300671	3.044856827	0.211646889	1821.643088	126.573689	0.229362975	0.015942937	137.2207305	

Notes:

University of California, Riverside Mobility Hub: Currently, 31 percent of UCR's population use RTA's services. UCR is one of the busiest transit destinations in the Agency's transit network, with over 1,700 boardings and alightings reported on an average weekday. Planned service improvements, the popular U-Pass Program, parking price increases, increased congestion, and resulting environmental and sustainability challenges are projected to contribute toward positive ridership gains in the future.

The current on-street bus stops at UCR located on Canyon Crest Drive are utilized by routes 1, 16, 51, 52, 204, and RapidLink Gold Line. This stop currently does not have the space, bus shelters or other amenities essential to effectively accommodate the current and planned service levels. The proposed UCR Mobility Hub would have an efficient bus turnaround to allow more direct routing, eliminating excess travel on local streets currently needed to turn the buses around.

The proposed UCR Mobility Hub will have capacity for six buses and be utilized by all routes

Abbreviations: MB = Bus; CB = Commuter Bus; DR =Demand Response; CR = Commuter Rail; PT = Purchased Transportation; DO = Directly Operated; VOMS = vehicles operated in maximum service; VRMs= vehicle revenue miles; TCR = The Climate Registry

1. Transit buses included here are those that stop, originate or terminate at UCR to encompass all transit use to get to Campus
2. Obtained from RTA SRTP FY19-FY21 - Table 3. https://www.riversidetransit.com/images/DOWNLOADS/PUBLICATIONS/SRTPS/FY2019-2021%20SRTP.pdf
3. Emission Factors obtained from EMFAC 2017. See EMFAC Working Page.
4. Conversion: 1,000 kg (or 1,000,000 g) = 1 MT
5. Sum of emissions include all emissions from the transit agencies that go through the UCR Campus and was a necessary step to calculating transit emissions actually associated with the UCR campus.

currently serving UCR. The project will also add amenities such as bus shelters, benches, trash receptacles, security features, drought-tolerant landscaping, traffic signalization, connectivity to UCR's bicycle amenities and better integration with the existing City of Riverside bike lanes and trails. This project reflects an ongoing partnership between UCR and RTA. These two agencies entered into a Memorandum of Understanding (MOU) in June 2017 to deliver the project. In addition to the mobility hub, UCR is going to improve bicycle and pedestrian connections throughout the campus, making it easier for students and faculty to access the hub. Conceptual Planning, A&E, construction bid documents and environmental clearance are completed. Construction bids were due in April and construction is slated for late 2019. A construction schedule will be determined by the awarded contractor.

TR.4.D. UCR Attributed Emissions from Transit[1]

Transit Agency	*Total Annual Revenue Miles (miles)* [2]	*Total Annual Passengers* [3]	*VRMs/Passenger* [4]	*UPASS Number of Riders* [5]	*Annual VRMs for UPASS Riders* [6]	*Proportion of UPASS miles to total RTA miles*	*Annual Emissions by Mode & Agency (MT CO_2e)*	*UCR GHG Emission Attribution (MT of CO2e)*
	miles	*passengers*	*miles/passenger*					
Riverside Transit	1941741	2639033	0.735777461	554,396	407912.0812	0.210075433	3537.159071	743.0702232

Notes:

1. ICELI CP Method TR.4.D. is used to attribute transit emissions (calculated with TR.4.A. & TR.4.B.) from the UCR Campus based on geographical bounds of the jurisdiction and total emissions produced by the transit mode. However, this method is not applicable since the emissions are better attributed by ridership, to better capture those who travel to UCR from longer distances. Emissions are attributed based on ridership of the 8 routes for which emissions are calculated above.
2. Transit routes within the campus were determined via 2018 Riverside Transit Agency (RTA) Rider Guide and confirmed through each transit agency mentioned.
3. Obtained from RTA SRTP FY19-FY21 - Table 3. https://www.riversidetransit.com/images/DOWNLOADS/PUBLICATIONS/SRTPS/FY2019-2021%20SRTP.pdf
4. Based on RTA annual trip data the average miles traveled per passenger was estimated.
5. RTA UPASS data was provided by UCR and includes number of riders on RTA routes including and excluding route 51. Data was collected on a fiscal year basis there fore UPASS ridership data from 1/1/2018 through 12/31/2018 was summed for 2018.
6. It is assumed that on average UPASS riders also have a similar VRM/passenger as the overall RTA system.

Waste Generation

SW.4 UCR-Generated Waste Sent to Landfills

Data Source [1]	*Tonnage generated* [2]	*Tonnage Diverted*	*Tonnage Disposed*	*Waste Material* [#]	*Emission factor* [4,5] *(MT CO2e/wet short ton)*	*CO_2e (MT)* [6]
Zero Waste Working Group Summary	5,255.19	3,799.69	1,455.50	MSW	0.11	160.105

Notes:

1. UCR provided community waste generation reports for the fiscal year that included total waste generated (MSW and C&D), waste diverted (through composting, recycling and facility recovery programs), and the total amount disposed of at a landfill. Calculations based on tonnage disposed.
2. Because data was provided on the fiscal year basis (June to June), Fiscal year 20172018 and 2018/2019 was averaged to get an estimate waste in 2018 calendar year. MSW and C&D waste have been combined.
3. Emission factors for Mixed MSW was used to represent waste sent to landfills based on waste description in provided source data.
4. Emission factor for landfilling obtained from EPA's WARM v15 for California Collection, dry climate (k = 0.02) and landfills with LFG recovery and flaring (determined via EPA GHG reports) such that waste in place for MSW = 0.32 MT CO2e.
5. Emission factor also incorporates emission reductions from net carbon storage (-0.21 MT CO2e). Transportation emissions have been calculated separately.

Zero Waste Working Group Supporting Data

Fiscal Year	Reuse (tons)	Recycle (tons)	Organics (tons)	Allowable Residual Conversion (tons)	Landfill and Non Allowable conversion (tons)	Total MSW Generation	Total MSW Diversion	C&D Recycled (tons)	C&D Landfill and non-allowable conversion (tons)	Total C&D Generation	Total Waste Generated (tons)	Total Waste Disposed at Landfill (tons)
2017-2018	522.00	1,042.00	812.00	426.00	1,458.00	4,260.00	2,802.00	1097	33	1130	5,390.00	1,491.00
2018-2019	615.00	980.00	832.00	423.00	1,383.00	4,233.00	2,850.00	850.38	37	887.38	5,120.38	1,420.00
Average	568.50	1,011.00	822.00	424.50	1,420.50	4,246.50	2,826.00	973.69	35.00	1,008.69	**5,255.19**	**1,455.50**
%	11%	19%	16%	8%	27%			19%	1%			**28%**
		Mixed Recyclables	Mixed Organics		Mixed MSW			C&D				

SW.5 Process Emissions Associated with Landfilling

Tonnage Disposed [1]	***El Sobrante***		***Badlands***		Total Emissions (MT CO2e)
	Emission factor (MT CO_2e/ton) [2]	*Process CO_2e (MT)*	*Emission factor* [2]	*Process CO_2e (MT)*	
1,455.50	0.0214	15.55	0.087422893	63.62201041	79.16964
		0.01068			

Notes:

1. UCR provided community waste generation reports that included total waste generated, waste diverted (through composting, recycling and facility recovery programs), and the total amount disposed of at a landfill. Calculations based on tonnage disposed. Tonnage disposed based on difference between tonnage generated (WCU variable in Zero Waste Working Group) and tonnage diverted (total diversion in Zero Waste Working Group)
2. Process emission factors based on the EPA GHG FLIGHT reports were used to estimate process/stationary emissions at the landfills attributed to UCR waste disposed assuming 50% of waste goes to each landfill

SW.6 Collection and Transportation Emissions

		Collection[2]		Transport[3]					
Tonnage Generated [1]	*Total Tonnage Disposed* [1]	*Emission Factor for Collection(MT CO2e/waste tonnage)*	*Collection Emissions CO_2e (MT)*	*Primary Landfills* [4]	*% of Total Distribution* [4]	*Estimated Waste Disposed by Landfill* [5]	*Distance to facility (miles)* [6]	*Emission Factor for Transport (MTCO2e/waste tonnage/mile)* [2]	*Transport Emissions CO_2e (MT)* [7]
5,255.19	1,455.50	0.02	105.1038	Badlands Sanitary Landfill	50%	728	28	0.00012	4.80315
				El Sobrante Landfill	50%	728	27		

Notes:

1. UCR provided community waste generation reports that included total waste generated, waste diverted (through composting, recycling and facility recovery programs), and the total amount disposed of at a landfill. Collection calculations based on tonnage generated and transport calculations based on tonnage disposed of at the landfills.
2. Per Feb 14, 2020 email from UCR Facilities Services, UCR hauls own waste to be landfilled to the CR&R facility in Perris. To avoid double counting of operation of fleet vehicles for waste collection, collection emissions will not be included. Collection emissions based on assumption the UCR fleet vehicles for waste hauling are diesel (ECF Diesel = 0.02), ICELI Default equation SW.6.
3. Transportation emission factor (EFT) of waste from the CR&R Station based on assumption that 50% of transport fuel is CNG and 50% is diesel per Perris Transfer Station, Material Recovery and Anaerobic Digestion Facility(2018); EFT are Diesel = 0.00014, CNG = 0.00010 per ICLEI Defaults SW.6
4. Primary landfills determined via Perris Transfer station/MRF (2018) and assuming even distribution of waste to either landfill.
5. Waste disposal by landfill was estimated based on waste disposal report for provided by UCR and assumed % of distribution of waste by landfill.
6. Transport distance from the center of UCR to the Perris CR&R was estimated via google maps.
7. Per ICELI CP "transportation emissions should be calculated for waste delivered to facilities outside the community's boundaries...Please note that the inclusion of long-haul emissions could result in double counting of transportation emissions."

Solid Waste Reference Data (internal use only)

Facility Name or Waste Group [1]	*SWISNo*	*% of Total Distribution* [1]	*LFG Collection/ Control System* [2]	*Estimated Efficiency* [3]	*Distance to facility (miles)* [4,5]	*Equipment Fuel* [6]	*2018 Waste (MT)* [6]	*2018 Waste (short ton)* [6]	*Process Emissions from Landfill (MT CO_2e)* [6]	*Stationary Combustion from Landfill (MT CO_2e)* [6]	*Calculated Landfill Process Emission Factor (MT CO2e/ton landfilled waste)*	*Calculated Landfill Stationary Combustion Factor (MT*	*Calculated Landfill Stationary Combustion and Processs Factor (MT CO2e/ton*
Badlands Sanitary Landfill	33-AA-0006	50.00%	Yes	63.80%	28	Landfill gas	810130	893016	78070	0	0.08742	0	0.087422893
El Sobrante Landfill	33-AA-0217	50.00%	Yes	52.18%	27	Propane	3166615	3490596	74336	237	0.02130	6.78967E-05	0.021363975

Notes:

1. Campus Facilities hauls waste to be landfilled to Perris CR&R which sends waste to either the El Sobrante Landfill or the Badlands Landfill. (Source: Perris Transfer Station/MRF, October 2018).
2. EPA's Landfill Methane Outreach Program (LMOP) database used to identify whether or not landfill had a landfill gas (LFG) control and collection system (https://www.epa.gov/lmop/project-and-landfill-data-state)
3. LFG capture rate efficiency was estimated by dividing the EPA reported LFG generated by the LFG collected.
4. Perris CR&R facility located at 1706 Goetz Road Perris, CA 92570; transport distance from the Perris CR&R to the landfills was estimated via google maps.
5. CR&R truck/hauler fleet is in the process of converting fleet to CNG fuel vs diesel. Therefore it is assumed to run at least 50% of its vehicles using CNG and 50% using diesel to transport landfill waste.
6. Process and stationary emissions at the landfill based on the EPA's GHGRP database FLIGHT (https://ghgdata.epa.gov/ghgp/main.do); (AR4 GWP) used)
7. Process and stationary emissions at the landfill based on the EPA's GHGRP database FLIGHT (https://ghgdata.epa.gov/ghgp/main.do); (AR4 GWP) used)
8. There are 1.10231131 short tons in a metric ton

2018 UCR GHG Emission Inventory

Emissions Summary

Scope/Category	UCR CCWG	2018	% of All Emissions	% within Scope
Scope 1	**24,343.00**	**20,135.69**	**20.7%**	**100.0%**
Stationary Combustion (Natural Gas)	22,869.00	18,410.07	18.9%	91.4%
Stationary Combustion (Other)		81.97	0.1%	0.4%
Fugitive Emissions	163.00	338.61	0.3%	1.7%
Mobile Combustion (Fleet)	1,311.00	1,305.04	1.3%	6.5%
Scope 2	**50,772.57**	**45,833.75**	**47.1%**	**100.0%**
Electricity Consumption	50,772.57	45,833.75	47.1%	100.0%
Scope 3	**29,651.00**	**31,262.65**	**32.2%**	**100.0%**
Business Travel	1,526.00	1,561.93	1.6%	5.0%
Passenger Mobile_On-site Transportation	28,125.00	26,341.59	27.1%	84.3%
Commercial Mobile_On-site Transportation		2,371.99	2.4%	7.6%
Transit_On-site Transportation		743.07	0.8%	2.4%
Waste		244.08	0.3%	0.8%
Total	**104,767**	**97,232**		
% of UCR CCWG that is LRDP Boundary		***90%***		

1. Percent of UCR that is main cmpus is based on only on emission sources that UCR reports through CCWG. This include scope 1 sources (Natural Gas combustion, fugitive emissions, mobile fleet combution), all of scope 2 emissions sources, and scope 3 sources (business travel, passenger/commuter on-site mobile emissions)

EMFAC DATA INVENTORY YEAR **2018**

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Region: Riverside (SC)
Calendar Year: 2018
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX
Riverside (SC)	2018	HHDT	Aggregated	Aggregated	GAS	10.15655092	563.7048197	203.2122708	1.021560854	0	0.000772463	0.331477112	1.396433852	0.083685554	0.144974084	1.406598277	0	0.00084575	0.331477112	1.39643385	0.08368555	0.144974084	42.95445585	0	5.174145922
Riverside (SC)	2018	HHDT	Aggregated	Aggregated	DSL	13937.90114	1747093.086	144362.4276	0.156547201	4.787596162	0	0	0	0	0	0.178217071	5.450313793	0	0	0	0	0	0.61041715	50.38425694	0
Riverside (SC)	2018	HHDT	Aggregated	Aggregated	NG	132.6075958	5385.40989	517.1696238	0.464211024	0.098378476	0	0	0	0	0	6.131186575	1.535580374	0	0	0	0	0	12.8860992	21.00115788	0
Riverside (SC)	2018	LDA	Aggregated	Aggregated	GAS	506416.9341	21886505.2	2394720.611	0.01632073	0	0.313471447	0.124764309	0.245881016	0.276114304	0.370026745	0.023467002	0	0.343190308	0.124764309	0.24588102	0.2761143	0.370026745	0.892602119	0	2.383586625
Riverside (SC)	2018	LDA	Aggregated	Aggregated	DSL	3972.142218	180788.8494	18989.08486	0.019326815	0	0	0	0	0	0	0.022002293	0	0	0	0	0	0	0.227358481	0	0
Riverside (SC)	2018	LDA	Aggregated	Aggregated	ELEC	3353.4939	123846.7604	17034.19648	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0
Riverside (SC)	2018	LDT1	Aggregated	Aggregated	GAS	54073.32552	2080381.839	242724.9474	0.056486837	0	0.635181306	0.343878861	1.138304066	0.753823873	1.150707262	0.081218455	0	0.695405411	0.343878861	1.13830407	0.75382387	1.150707262	2.313116069	0	2.775320706
Riverside (SC)	2018	LDT1	Aggregated	Aggregated	DSL	39.67801488	866.4912044	131.6189082	0.253302909	0	0	0	0	0	0	0.288368521	0	0	0	0	0	0	1.51285063	0	0
Riverside (SC)	2018	LDT1	Aggregated	Aggregated	ELEC	44.27373647	1483.049212	217.2199587	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0
Riverside (SC)	2018	LDT2	Aggregated	Aggregated	GAS	163935.0153	6759901.851	764833.1584	0.026949694	0	0.444579055	0.161393605	0.488096783	0.398914201	0.500934338	0.03840514	0	0.486728482	0.161393605	0.48809678	0.3989142	0.500934338	1.296433758	0	3.13853121
Riverside (SC)	2018	LDT2	Aggregated	Aggregated	DSL	550.4581733	27432.66729	2717.115602	0.022463717	0	0	0	0	0	0	0.025573448	0	0	0	0	0	0	0.140152113	0	0
Riverside (SC)	2018	LDT2	Aggregated	Aggregated	ELEC	417.386745	14487.3033	2146.939848	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0
Riverside (SC)	2018	LHDT1	Aggregated	Aggregated	GAS	16493.20118	557401.343	245724.1228	0.046750484	0.476576743	0.172470495	0.157360437	0.989202344	0.040282001	0.082004483	0.06553094	0.694454574	0.188734642	0.157360437	0.98920234	0.040282	0.082004483	1.270460996	3.738039469	1.912239789
Riverside (SC)	2018	LHDT1	Aggregated	Aggregated	DSL	15589.55126	571132.9909	196096.9432	0.10917461	0.109759705	0	0	0	0	0	0.124288035	0.124954127	0	0	0	0	0	0.747248502	0.909745076	0
Riverside (SC)	2018	LHDT2	Aggregated	Aggregated	GAS	2243.091526	77131.32966	33418.72153	0.028076603	0.478173293	0.151707487	0.128248919	0.813016657	0.032915337	0.06592272	0.040859487	0.697707896	0.166096321	0.128248919	0.81301666	0.03291534	0.06592272	0.766373605	3.751618729	1.80733614
Riverside (SC)	2018	LHDT2	Aggregated	Aggregated	DSL	5832.260313	217280.4939	73362.49775	0.090730775	0.109759705	0	0	0	0	0	0.103290955	0.124954127	0	0	0	0	0	0.613829126	0.909745076	0
Riverside (SC)	2018	MCY	Aggregated	Aggregated	GAS	27046.02448	195083.3295	54092.04897	2.222814414	0	1.879525715	0.775299527	2.036840332	1.47869853	2.765268315	2.702003195	0	2.044407669	0.775299527	2.03684033	1.47869853	2.765268315	20.57519223	0	8.541003749
Riverside (SC)	2018	MDV	Aggregated	Aggregated	GAS	153860.1899	5973363.917	707853.7687	0.037617045	0	0.58513726	0.179561133	0.519252987	0.457192328	0.54591759	0.052260771	0	0.640553524	0.179561133	0.51925299	0.45719233	0.54591759	1.551259093	0	3.826799371
Riverside (SC)	2018	MDV	Aggregated	Aggregated	DSL	2274.968291	106045.7708	11206.48527	0.013604592	0	0	0	0	0	0	0.015487924	0	0	0	0	0	0	0.19624681	0	0
Riverside (SC)	2018	MDV	Aggregated	Aggregated	ELEC	59.95139476	2024.361014	305.163866	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0
Riverside (SC)	2018	MH	Aggregated	Aggregated	GAS	5776.734287	48825.67457	577.904498	0.083561773	0	0.157042844	0.10323097	2.334268689	0.062642038	0.181860893	0.118928805	0	0.171854078	0.10323097	2.33426869	0.06264204	0.181860893	2.752022426	0	3.246427694
Riverside (SC)	2018	MH	Aggregated	Aggregated	DSL	1998.535936	18039.37033	199.8535936	0.075449173	0	0	0	0	0	0	0.085893868	0	0	0	0	0	0	0.366798444	0	0
Riverside (SC)	2018	MHDT	Aggregated	Aggregated	GAS	1231.972811	49072.04487	24649.31201	0.118553524	0.994156517	0.278826966	0.122503705	0.587810558	0.037500619	0.075020648	0.169879903	1.446957502	0.305007734	0.122503705	0.58781056	0.03750062	0.075020648	3.330457599	14.23433673	5.631632235
Riverside (SC)	2018	MHDT	Aggregated	Aggregated	DSL	11748.72911	697258.5636	116104.2417	0.202890773	0.180120077	0	0	0	0	0	0.2309757	0.205052996	0	0	0	0	0	0.726468133	2.43220991	0
Riverside (SC)	2018	OBUS	Aggregated	Aggregated	GAS	451.6254813	17395.98667	9036.12263	0.088903071	0.743401273	0.191654193	0.033144557	0.334316361	0.028214594	0.066763253	0.128074911	1.083309163	0.209697681	0.033144557	0.33431636	0.02821459	0.066763253	2.472495967	5.751498171	3.731405269
Riverside (SC)	2018	OBUS	Aggregated	Aggregated	DSL	222.2340298	14449.00221	2122.128661	0.31852574	1.565172546	0	0	0	0	0	0.362617308	1.7818298	0	0	0	0	0	1.038233033	12.57379782	0
Riverside (SC)	2018	SBUS	Aggregated	Aggregated	GAS	376.9613183	14179.05722	1507.845273	0.069058907	10.62815655	0.330213658	0.061331808	0.456028016	0.016350402	0.035402811	0.100770595	15.50858109	0.36154239	0.061331808	0.45602802	0.0163504	0.035402811	1.589539427	82.16102126	8.047309216
Riverside (SC)	2018	SBUS	Aggregated	Aggregated	DSL	772.6394382	24525.52044	8916.151995	0.144183169	0.301746543	0	0	0	0	0	0.164141562	0.343515469	0	0	0	0	0	0.379228837	4.557500669	0
Riverside (SC)	2018	UBUS	Aggregated	Aggregated	GAS	160.6686045	22621.30502	642.6744181	0.01192563	0	0.252114922	0.046413866	0.217701689	0.013158412	0.020864306	0.017401851	0	0.276034106	0.046413866	0.21770169	0.01315841	0.020864306	0.22438307	0	4.1929121
Riverside (SC)	2018	UBUS	Aggregated	Aggregated	DSL	1.105797941	58.57190354	4.423191762	0.000535102	0	0	0	0	0	0	0.03822159	0	0	0	0	0	0	0.057156358	0	0
Riverside (SC)	2018	UBUS	Aggregated	Aggregated	ELEC	0.058469431	1.251702935	0.233877724	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverside (SC)	2018	UBUS	Aggregated	Aggregated	NG	199.3922535	26236.00395	797.5690139	0.080967207	0	0	0	0	0	0	5.783371905	0	0	0	0	0	0	43.79874467	0	0

Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
Passenger Vehicles											
Riverside (SC)	2018	LDA	DSL	3972.142218	180788.8494	0.48%	180788.8494	214.3980961	0.000897694	0.0337004	223.3538362
Riverside (SC)	2018	LDT1	DSL	39.67801488	866.4912044	0.00%	866.4912044	410.803667	0.011765436	0.0645726	428.2448424
Riverside (SC)	2018	LDT2	DSL	550.4581733	27432.66729	0.07%	27432.66729	292.7118864	0.001043397	0.0460102	304.9338131
Riverside (SC)	2018	MDV	DSL	2274.968291	106045.7708	0.28%	106045.7708	391.3118004	0.000631907	0.0615088	407.6293167
Riverside (SC)	2018	LDA	ELEC	3353.4939	123846.7604	0.33%	123846.7604	0	0	0	0
Riverside (SC)	2018	LDT1	ELEC	44.27373647	1483.049212	0.00%	1483.049212	0	0	0	0
Riverside (SC)	2018	LDT2	ELEC	417.386745	14487.3033	0.04%	14487.3033	0	0	0	0
Riverside (SC)	2018	MDV	ELEC	59.95139476	2024.361014	0.01%	2024.361014	0	0	0	0
Riverside (SC)	2018	MCY	GAS	27046.02448	**195083.3295**	0.52%	195083.3295	207.5566169	0.3236514	0.065871603	234.074831
Riverside (SC)	2018	LDA	GAS	506416.9341	21886505.2	58.59%	21886505.2	287.7413246	0.003927691	0.006098569	289.4674207
Riverside (SC)	2018	LDT1	GAS	54073.32552	2080381.839	5.57%	2080381.839	338.764006	0.012260389	0.000719833	339.2980527
Riverside (SC)	2018	LDT2	GAS	163935.0153	6759901.851	18.10%	6759901.851	371.7498948	0.006135387	0.000791724	372.1314926
Riverside (SC)	2018	MDV	GAS	153860.1899	5973363.917	15.99%	5973363.917	453.9384923	0.008087889	0.000970947	454.4222541
		Passenger Vehicle Total			***37352211.39***			**330.7990891**	**0.007085614**	**0.004629168**	**332.2242159**
		Passenger Gasoline Total			**36895236.14**	**98.78%**		**331.3962553**	**0.005454803**	**0.003960557**	**332.5985374**
		Passenger Diesel Total			**315133.7787**	**0.84%**		**281.2887039**	**0.000850819**	**0.044214667**	**293.0294136**
		Passenger Electric Total			**141841.4739**	**0.38%**		**0**	**0**	**0**	**0**
Light-Heavy Trucks											
Riverside (SC)	2018	LHDT1	DSL	15589.55126	571132.9909	40.14%	571132.9909	501.3704868	0.005070952	0.078808459	522.396715
Riverside (SC)	2018	LHDT2	DSL	5832.260313	217280.4939	15.27%	217280.4939	545.9248546	0.004214271	0.085811785	568.7829771
Riverside (SC)	2018	LHDT1	GAS	16493.20118	557401.343	39.17%	557401.343	807.1287357	0.009209913	0.018556342	812.3040438
Riverside (SC)	2018	LHDT2	GAS	2243.091526	77131.32966	5.42%	77131.32966	923.4156914	0.006187685	0.017054601	928.108416
		Light-Heavy Truck Total			***1422946.157***			**650.8236199**	**0.006622**	**0.052928293**	**665.0350336**
		Light-Heavy Truck Gasoline Total			**634532.6727**	**44.59%**		**821.2641268**	**0.008842543**	**0.018373796**	**826.380774**
		Light-Heavy Truck Diesel Total			**788413.4848**	**55.41%**		**513.6493167**	**0.004834858**	**0.08073852**	**535.1804004**
Medium-Heavy Trucks											
Riverside (SC)	2018	MHDT	DSL	11748.72911	697258.5636	93.42%	697258.5636	979.7309893	0.009423751	0.154000068	1020.804872
Riverside (SC)	2018	MHDT	GAS	1231.972811	49072.04487	6.58%	49072.04487	1679.051963	0.023059596	0.038727655	1689.96046
		Medium-Heavy Truck Total			***746330.6085***			**1025.7121**	**0.010320322**	**0.146420782**	**1064.802576**
		Medium-Heavy Truck Gasoline Total			**49072.04487**	**6.58%**		**1679.051963**	**0.023059596**	**0.038727655**	**1689.96046**
		Medium-Heavy Truck Diesel Total			**697258.5636**	**93.42%**		**979.7309893**	**0.009423751**	**0.154000068**	**1020.804872**
Heavy-Heavy Trucks											
Riverside (SC)	2018	HHDT	DSL	13937.90114	1747093.086	99.66%	1747093.086	1442.756916	0.007271212	0.226781296	1503.057553
Riverside (SC)	2018	HHDT	GAS	10.15655092	563.7048197	0.03%	563.7048197	2218.131977	0.174581754	0.201233616	2276.347175
Riverside (SC)	2018	HHDT	NG	132.6075958	5385.40989	0.31%	5385.40989	3390.077554	5.578321069	0.691089486	3729.409258
		Heavy-Heavy Truck Total			***1753042.201***			**1448.988484**	**0.024439481**	**0.228199452**	**1510.145645**
		Heavy-Heavy Truck Gasoline Total			**563.7048197**	**0.03%**		**2218.131977**	**0.174581754**	**0.201233616**	**2276.347175**
		Heavy-Heavy Truck Diesel Total			**1747093.086**	**99.66%**		**1442.756916**	**0.007271212**	**0.226781296**	**1503.057553**
		Heavy-Heavy Truck NG Total			**5385.40989**	**0.31%**		**3390.077554**	**5.578321069**	**0.691089486**	**3729.409258**
Urban Buses											
Riverside (SC)	2018	UBUS	GAS	160.6686045	22621.30502	**46.30%**	22621.30502	1475.060624	0.003963582	0.017998277	1479.941148
Riverside (SC)	2018	UBUS	NG	199.3922535	26236.00395	**53.70%**	26236.00395	1857.263508	5.666787124	0.378615316	1
		Urban Bus Total			***48857.30897***			**1680.300671**	**3.044856827**	**0.211646889**	**1821.643088**
		Urban Bus Gasoline Total			**22621.30502**	**46.30%**		**1475.060624**	**0.003963582**	**0.017998277**	**1479.941148**
		Urban Bus NG Total			**26236.00395**	**53.70%**		**1857.263508**	**5.666787124**	**0.378615316**	**2116.266607**

NOx_RUNEX	NOx_IDLEX	NOx_STREX	CO2_RUNEX	CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW	PM2_5_RUNEX	PM2_5_IDLEX	PM2_5_STREX	PM2_5_PMTW	PM2_5_PMBW	SOx_RUNEX	SOx_IDLEX	SOx_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX
6.700165136	0	0.628042704	2218.131977	0	61.33858763	0.174581754	0	0.000150502	0.001768155	0	0.002336071	0.020000006	0.061740018	0.001648984	0	0.002197768	0.005000001	0.026460008	0.021950214	0	0.000606995	0.201233616	0	0.015195314
4.762428406	64.04598899	1.472897983	1442.756916	10899.01599	0	0.007271212	0.222371442	0	0.094655644	0.217702467	0	0.035276743	0.060499614	0.090560883	0.208284755	0	0.008819186	0.025928406	0.013630452	0.102968499	0	0.226781296	1.713173537	0
4.370559855	27.20147205	0	3390.077554	4048.550986	0	5.578321069	1.417403729	0	0.008570754	0.08214541	0	0.03600001	0.061740018	0.008199987	0.078591836	0	0.009000003	0.026460008	0	0	0	0.691089486	0.825323603	0
0.062102073	0	0.235691081	287.7413246	0	60.40122281	0.003927691	0	0.067501787	0.001430963	0	0.002026923	0.008000002	0.036750011	0.001316054	0	0.001864668	0.002000001	0.015750005	0.002847434	0	0.000597719	0.006098569	0	0.029711898
0.144096972	0	0	214.3980961	0	0	0.000897694	0	0	0.011394452	0	0	0.008000002	0.036750011	0.010901533	0	0	0.002000001	0.015750005	0.002026833	0	0	0.033700395	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.008000002	0.036750011	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
0.222271601	0	0.407813967	338.764006	0	72.74122948	0.012260389	0	0.119256909	0.002801163	0	0.003633731	0.008000002	0.036750011	0.0025768	0	0.003342866	0.002000001	0.015750005	0.003352344	0	0.000719833	0.014924931	0	0.03706505
1.459319213	0	0	410.803667	0	0	0.011765436	0	0	0.199245146	0	0	0.008000002	0.036750011	0.190625889	0	0	0.002000001	0.015750005	0.003883572	0	0	0.064572616	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.008000002	0.036750011	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
0.134824896	0	0.415033683	371.7498948	0	80.00602056	0.006135387	0	0.092030159	0.001550769	0	0.002090336	0.008000002	0.036750011	0.001426738	0	0.001923266	0.002000001	0.015750005	0.003678767	0	0.000791724	0.009976777	0	0.040819615
0.094527093	0	0	292.7118864	0	0	0.001043397	0	0	0.011906547	0	0	0.008000002	0.036750011	0.011391475	0	0	0.002000001	0.015750005	0.00276718	0	0	0.046010232	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.008000002	0.036750011	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
0.314384563	0.041585137	0.591650752	807.1287357	124.3353554	19.66718943	0.009209913	0.129550202	0.033864407	0.001205737	0	0.000535417	0.008000002	0.076440022	0.001110886	0	0.000494696	0.002000001	0.032760009	0.007987193	0.001230399	0.000194623	0.018556342	0.003186557	0.044936172
3.927102338	2.513982157	0	501.3704868	140.8379554	0	0.005070952	0.005098128	0	0.024667129	0.027532686	0	0.012000003	0.076440022	0.02360004	0.026341634	0	0.003000001	0.032760009	0.004739754	0.001331425	0	0.078808459	0.022137765	0
0.267837867	0.041730043	0.587561668	923.4156914	143.3087859	22.01594333	0.006187685	0.13254647	0.030738972	0.000961317	0	0.000385566	0.008000002	0.089180026	0.000883999	0	0.000354617	0.002000001	0.038220011	0.009137947	0.001418157	0.000217866	0.017054601	0.00324386	0.04486558
3.117618493	2.5189607	0	545.9248546	226.3604234	0	0.004214271	0.005098128	0	0.021430641	0.027168531	0	0.012000003	0.089180026	0.020503561	0.025993232	0	0.003000001	0.038220011	0.005160953	0.00213992	0	0.085811785	0.035580706	0
1.141647567	0	0.261929969	207.5566169	0	61.92051458	0.3236514	0	0.247937075	0.001561023	0	0.003000047	0.004000001	0.011760003	0.001464868	0	0.002835561	0.001	0.005040001	0.002053941	0	0.000612754	0.065871603	0	0.014936437
0.173224094	0	0.510064618	453.9384923	0	98.11693176	0.008087889	0	0.114890312	0.001563472	0	0.002246463	0.008000002	0.036750011	0.001439632	0	0.002068887	0.002000001	0.015750005	0.004492089	0	0.000970947	0.012457695	0	0.044956177
0.099701948	0	0	391.3118004	0	0	0.000631907	0	0	0.006987988	0	0	0.008000002	0.036750011	0.00668569	0	0	0.002000001	0.015750005	0.003699304	0	0	0.061508766	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.008000002	0.036750011	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
0.57048517	0	0.314299602	1705.735164	0	27.34887804	0.017961081	0	0.035964633	0.001384189	0	0.000435742	0.012000003	0.130340037	0.001274541	0	0.000402161	0.003000001	0.055860016	0.016879632	0	0.000270639	0.032091265	0	0.031717076
4.911256984	0	0	954.3175829	0	0	0.00350447	0	0	0.1587474	0	0	0.016000005	0.130340037	0.151880058	0	0	0.004000001	0.055860016	0.009021733	0	0	0.150005434	0	0
0.866909838	0.088507852	0.408859534	1679.051963	559.0957838	42.55992244	0.023059596	0.243602006	0.047552436	0.001043973	0	0.000669356	0.012000003	0.130340037	0.000961754	0	0.000619894	0.003000001	0.055860016	0.01661558	0.005532706	0.000421165	0.038727655	0.006494669	0.027693413
4.212295005	10.67236193	0.91665979	979.7309893	872.5678364	0	0.009423751	0.008366111	0	0.153911508	0.053438653	0	0.012000003	0.130340037	0.147253364	0.05112692	0	0.003000001	0.055860016	0.009256013	0.008243588	0	0.154000068	0.137155513	0
0.742877561	0.064804371	0.338376793	1702.172628	388.9920632	28.33218967	0.018070401	0.191486458	0.034726244	0.000671159	0	0.000314325	0.012000003	0.130340037	0.000618082	0	0.00029135	0.003000001	0.055860016	0.016844378	0.003849392	0.00028037	0.034266494	0.00508438	0.024840495
6.110698952	26.74413256	0.881864965	1194.848416	2654.165236	0	0.014794696	0.072698211	0	0.197573847	0.195842173	0	0.012000003	0.130340037	0.18902689	0.187370128	0	0.003000001	0.055860016	0.011288335	0.025075237	0	0.187813532	0.417197814	0
0.376546848	0.92565639	0.522856132	904.0519178	2688.552693	49.23902052	0.013309052	2.384244736	0.056445059	0.000736892	0	0.000301265	0.008000002	0.744800204	0.000677545	0	0.000277002	0.002000001	0.319200087	0.008946327	0.026605408	0.00048726	0.022660083	0.086478612	0.048803067
8.185596203	51.19625771	0.454607149	1276.47381	3809.648291	0	0.006696935	0.014015345	0	0.053155008	0.067685766	0	0.012000003	0.744800213	0.050855546	0.06475771	0	0.003000001	0.319200091	0.012059492	0.035991668	0	0.200643907	0.598823659	0
0.184530403	0	0.60819851	1475.060624	0	54.99140207	0.003963582	0	0.064770417	0.00034029	0	0.000135159	0.009546243	0.105090841	0.000312884	0	0.000124273	0.002386561	0.045038932	0.014596921	0	0.000544185	0.017998277	0	0.060576953
0.477460704	0	0	1141.140363	0	0	0.037451096	0	0	0.004270345	0	0	0.012000007	0.130340079	0.004085612	0	0	0.003000002	0.055860034	0.01078788	0	0	0.179371374	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.012000007	0.130340079	0	0	0	0.003000002	0.055860034	0	0	0	0	0	0
0.442851769	0	0	1857.263508	0	0	5.666787124	0	0	0.003035405	0	0	0.029459382	0.080435367	0.002904095	0	0	0.007364845	0.0344723	0	0	0	0.378615316	0	0

Enter Forecast Data

Campus Growth

Year	Student Population	Faculty/Staff Population	Campus Population
2018	23,922	4,739	28,661
2035	35,000	7,545	42,545

Building Square Footage	Academics & Research	Academic Support	Student Life	Other	Campus LRDP Building Total
2018	1,220,283	1,458,975	1,875,963	248,279	4,803,500
2035	2,551,277	3,532,806	6,297,756	372,419	12,754,258

Electricity Emission Factors		
Baseline Year Emission factor:	0.4280	MT CO2e/MWh
Select Electricity Provider:	RPU	
	Year	RPS (percentage)
Baseline Year	2018	0.35

Transportation Forecast Data

	Forecast Year Annual VMT		
Vehicle Class	2030	2035	2045
Passenger	127,676,851	132,342,053	141,672,456
Light-Heavy Duty	1,185,276	1,224,441	1,302,770
Medium-Heavy Duty	1,100,867	1,098,630	1,094,157
Heavy-Heavy-Duty	1,715,753	1,738,033	1,782,593
Total	131,678,748	136,403,157	145,851,976

Inventory Year	**2018**

Data From Inventory (Units)	Year Activity Data	Year Emissions MTCO2e
Forecasting Factors		
Baseline Buildings (SF)	4,803,500	
Students Population	23,922	
Staff Population	4,739	
Campus Population	28,661	
Energy		
Baseline Electricity (kWh)	118,960,675	45,834
Baseline Natural Gas (Therms)	3,466,942	18,410
Baseline Diesel (Gallons)	8,003	82
Fugitive		
Baseline Refrigerant		339
Campus Fleet		
Gasoline (Gal)	135,192	1,200
Diesel (Gal)	7,306	29
CNG (scf)	4,321	75
Business Travel		
Air Travel (miles)	8,273,344	1,562
On Site Transport		
Passenger (VMT)	79,581,443	26,342
Light-Heavy Duty (VMT)	607,005	404
Medium-Heavy Duty (VMT)	577,080	614
Heavy-Heavy-Duty (VMT)	896,490	1,354
Public Transit		
Attributed VMT	407,912	743
Waste		
Waste Generation (short tons)	1,456	244

BAU Emission Growth Metrics (Units)	
Energy	
Baseline Electricity (kWh/SF)	24.765
Baseline NG (Therms/SF)	0.722
Baseline Diesel (Gal/SF)	0.002
Fugitive	
Baseline Refrigerant (MT CO2e/SF)	0.00007
Campus Fleet	
Gasoline (Gal/CP)	4.7
Diesel (Gal/CP)	0.3
CNG (scf/CP)	0.2
Business Travel	
Air Travel (miles per Staff)	1,746
On Site Transport	
Passenger (VMT/CP)	2,777
Light-Heavy Duty (VMT/CP)	21
Medium-Heavy Duty (VMT/CP)	20
Heavy-Heavy-Duty (VMT/CP)	31
Public Transit	
Attributed VMT per CP	14
Waste	
Waste Generation (short tons/CP)	0.0508

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Building Removal Operational GHG Emissions (-)

List 1 - Removal in 5-10 years

LRDP Land Use	Building Type (Brightworks)	Gross Square Footage	Current (Existing Building) EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTu/year)
Academics & Research	Lab/Complex	179,713	253	17,945,595
	Academic/Admin	112,693	107	2,876,089
Canyon Crest Gateway	Residential	186,083	83	7,226,626
Student Neighborhood	Social	72,544	180	4,570,272
List 1 Subtotal		*551,033*		*32,618,582*

List 2 - Removal in 10-15 years

LRDP Land Use	Building Type (Brightworks)	Gross Square Footage	Current EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTu/year)
Academics & Research	Lab/Complex	1,740	253	176,088
	Academic/Admin	65,258	107	2,094,719
Canyon Crest Gateway	Residential	312,949	83	11,860,573
Student Neighborhood	Social		180	
List 2 Subtotal		*379,946*		*14,131,380*
TOTAL		**930,979**		**46,749,962**

Building Demo GHG Emissions (+)

List 1 - Removal in 5-10 years

LRDP Land Use	Campus Area/Facility Name	Gross Square Footage	Demolition Emissions (MT CO_2e)
Academics & Research	Boyden Labs	8,781	7
Academics & Research	Fawcett Laboratory	21,001	25
Academics & Research	South Campus Drive Facilities	7,269	7
Academics & Research	South District/Toe of the Hill south of South Cam	34,626	41
Academics & Research	Northwest of East Campus Drive and north of Eu	30,416	27
Academics & Research	Northwest of East Campus Drive and south of Eu	15,067	25
Academics & Research	East of East Campus Drive and northeast of Euca	33,065	27
Academics & Research	East of East Campus Drive and southeast of Euca	22,276	26
Academics & Research	Former EH&S complex	9,736	24
Academics & Research	Reprographics Trailer on Commons Mall	1,965	6
Academics & Research	Health Services Building (Veitch - Student Health	23,333	39
Canyon Crest Gateway, Student Neighborhood, Open Space Reserve	Bannockburn Village	181,680	63
Student Neighborhood	Plaza Apartments	72,544	47
Student Neighborhood, Campus Support	Corporation Yard	73,797	47
University Avenue Gateway	Softball and soccer fields	3,629	36
Academics & Research	College Building2	18,642	9
List 1 Subtotal		*557,826*	*454*

List 2 - Removal in 10-15 years

LRDP Land Use	Campus Area/Facility Name	Gross Square Footage	Demolition Emissions (MT CO_2e)
Academics & Research	FMRI	1,740	6
Academics & Research	Costo Hall	20,317	25
Academics & Research	University Office Bldg.	20,288	9
Academics & Research	Campbell Hall	12,269	8
Canyon Crest Gateway	Police Facility	9,609	24
Canyon Crest Gateway, Student Neighborhood	Oban Apartments - East Side along Canyon Crest	106,840	39

Electricity (kWh/year)
7,889,329
1,966,848
2,588,672
2,487,587
14,932,436

Electricity (kWh/year)
77,413
1,432,495
4,248,614
5,758,522
20,690,958

Canyon Crest Gateway, Student Neighborhood	Falkirk Apartments - East Side along Canyon Cres	156,390	46
List 2 Subtotal		*327,453*	*156*
TOTAL		**885,279**	**611**

LRDP Building Construction GHG Emissions (+)

**Scenarios per data source "programmodel_09182019_DRAFT"*

LRDP Land Use	2018-2035 Building Change (ASF)		New Construction (GSF)	CalEEMod Land Use	Construction Emi
Academics & Research					
Classroom & Services	176,970		**265,455**		
Classroom & Services (seats)	6031			Educational - University/College 4Yr	
Teaching Lab & Services	63071		**94,607**		
Open Lab & Service	12,757		**19,136**		
Research Lab & Service	178,090		**267,135**		
Academic Support					
Offices & Services	586,581		**879,872**	Commercial - General Office Building	
Library & Collaborative Learning Space	177,238		**265,857**	Educational - Library	
Assembly & Exhibit	62,012		**93,018**	Recreational - Movie Theater	
Other Department Space	70,398		**105,597**	Commercial - Research & Development	
Student Life					
Residences	2,117,973		**3,176,960**	Residential - Apartments Mid Rise	
Residential Dining	38,725		**58,088**	Recreational - High Turnover Restaurant	
Student Health	10,383		**15,575**	Commercial - Medical Office Building	
Student Union	90,300		**135,450**	Retail - Strip Mall	
Recreation Indoors	65,160		**97,740**	Recreational - Health Club	
Recreation Outdoors	4	**Acres**		Recreational - City park/ Golf Course?	
Athletics	0		**0**	N/A	
Other					
Corporation Yard	0		**0**	N/A	
TOTAL			5474487		

BUILDING INPUTS	*Existing Buildings*			
	EUI (kBTu/ sf-yr.)		***% Gas***	
	Current	Energy Upgrades	Current	Energy Upgrades
Academic/Admin	107.0	45.0	30%	14%
Lab/Complex	253.0	155.0	40%	50%
Residential	83.0	43.0	45%	34%
Social	180.0	100.0	35%	32%

LRDP Building C

LRDP Land Use	Brightworks Designation	2018-2035 Building Change (ASF)	New Construction (GSF)	% Attribution within LRDP Land Use
Academics & Research				

ssions (MT CO_2e) Unmitigated
524
1303
344
68
525
921
525
341
342
8438
258
67
417
345
345
0
0
14763

					New Buildings
% Electricity		*EUI (kBTu/ sf-yr.)*			*% Ga*
Current	Energy Upgrades	Code	High Performance	Code	
70%	86%	65.0	39.0	16%	
60%	50%	149.0	136.0	42%	
55%	66%	57.0	34.0	48%	
65%	68%	107.0	88.0	29%	

)perational Emissions (+) (Legislative Adjusted Forecast)

Estimated Operational Energy Use for New Buildings			Energy Factors for LRDP Land Use	
Code (New Building) EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTu/year)	Electricity (kWh/year)	Weighted LRDP Land Use EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTU/sf/year)

ıs	% Electric	
High Performance	Code	High Performance
10%	84%	90%
42%	58%	58%
34%	52%	66%
26%	71%	74%

Electricity Usage (kWh/sf/year)

Classroom & Services	Academic/Admin	176,970	**265,455**	41%
Teaching Lab & Services	Lab/Complex	63071	**94,607**	15%
Open Lab & Service	Lab/Complex	12,757	**19,136**	3%
Research Lab & Service	Lab/Complex	178,090	**267,135**	41%
Academic Support				
Offices & Services	Academic/Admin	586,581	**879,872**	65%
Library & Collaborative Learning Space	Academic/Admin	177,238	**265,857**	20%
Assembly & Exhibit	Academic/Admin	62,012	**93,018**	7%
Other Department Space	Academic/Admin	70,398	**105,597**	8%
Student Life				
Residences	Residential	2,117,973	**3,176,960**	91%
Residential Dining	Social	38,725	**58,088**	2%
Student Health	Lab/Complex	10,383	**15,575**	0%
Student Union	Social	90,300	**135,450**	4%
Recreation Indoors	Social	65,160	**97,740**	3%
Recreation Outdoors	N/A	4 **Acres**		
Athletics	N/A	0	**0**	
Other				
Corporation Yard	Academic/Admin	0	**0**	
TOTAL		**3,649,658**	**5,474,487**	

*Scenarios per data source "programmodel_09182019_DRAFT"

* LRDP Land Use designation by Brightworks building type was determined based off building data provided by UCR in the Brightworks analysis and the "Opportunity Site Potential List" for specific buildings. (See "Bldg. Summary" tab for compila

* 1 kbtu = 3.412 kWh

Existing Building EUI - For BAU forecast

LRDP Land Use	Brightworks Designation	2018-2035 Building Change (ASF)	New Construction (GSF)	% Attribution within LRDP Land Use
Academics & Research				
Classroom & Services	Academic/Admin	176,970	**265,455**	41%
Teaching Lab & Services	Lab/Complex	63071	**94,607**	15%
Open Lab & Service	Lab/Complex	12,757	**19,136**	3%
Research Lab & Service	Lab/Complex	178,090	**267,135**	41%
Academic Support				
Offices & Services	Academic/Admin	586,581	**879,872**	65%
Library & Collaborative Learning Space	Academic/Admin	177,238	**265,857**	20%
Assembly & Exhibit	Academic/Admin	62,012	**93,018**	7%
Other Department Space	Academic/Admin	70,398	**105,597**	8%
Student Life				
Residences	Residential	2,117,973	**3,176,960**	91%
Residential Dining	Social	38,725	**58,088**	2%
Student Health	Lab/Complex	10,383	**15,575**	0%
Student Union	Social	90,300	**135,450**	4%
Recreation Indoors	Social	65,160	**97,740**	3%
Recreation Outdoors	N/A	4 **Acres**		
Athletics	N/A	0	**0**	
Other				
Corporation Yard	Academic/Admin	0	**0**	

65	2,760,732	4,247,902	115	41.1
149	5,920,475	2,396,217		
149	1,197,500	484,669		
149	16,717,308	6,766,063		
65	9,150,664	14,080,007	65	10.4
65	2,764,913	4,254,335		
65	967,387	1,488,506		
65	1,098,209	1,689,800		
57	86,921,612	27,598,206	62	27.8
107	1,802,455	1,293,349		
149	974,652	394,475		
107	4,203,014	3,015,867		
107	3,032,872	2,176,233		
	-	-		
65	-	-	65	10
	137,511,792	**69,885,630**		

ıtion of data

Current EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTu/year)	Electricity (kWh/year)	Weighted LRDP Land Use EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTU/sf/year)
107	4,544,590	6,992,701	193	69.6
253	10,052,887	4,068,745		
253	2,033,338	822,961		
253	28,385,765	11,488,684		
107	15,063,400	23,177,858	107	17.1
107	4,551,472	7,003,290		
107	1,592,468	2,450,310		
107	1,807,821	2,781,670		
83	126,570,066	40,186,862	92	41.2
180	3,032,168	2,175,728		
253	1,654,946	669,813		
180	7,070,490	5,073,420		
180	5,102,028	3,660,953		
	-	-		
107	-	-	107	17

21.5
16.0
9.9
16

Electricity Usage (kWh/sf/year)
36.2
26.3
14.9
26

TOTAL		**3,649,658**	**5,474,487**	

1 Kbtu = 0.0100 therm

LRDP Buildir

LRDP Land Use	Brightworks Designation	2018-2035 Building Change (ASF)	New Construction (GSF)	% Attribution within LRDP Land Use
Academics & Research				
Classroom & Services	Academic/Admin	176,970	**265,455**	41%
Teaching Lab & Services	Lab/Complex	63071	**94,607**	15%
Open Lab & Service	Lab/Complex	12,757	**19,136**	3%
Research Lab & Service	Lab/Complex	178,090	**267,135**	41%
Academic Support				
Offices & Services	Academic/Admin	586,581	**879,872**	65%
Library & Collaborative Learning Space	Academic/Admin	177,238	**265,857**	20%
Assembly & Exhibit	Academic/Admin	62,012	**93,018**	7%
Other Department Space	Academic/Admin	70,398	**105,597**	8%
Student Life				
Residences	Residential	2,117,973	**3,176,960**	91%
Residential Dining	Social	38,725	**58,088**	2%
Student Health	Lab/Complex	10,383	**15,575**	0%
Student Union	Social	90,300	**135,450**	4%
Recreation Indoors	Social	65,160	**97,740**	3%
Recreation Outdoors	N/A	4 **Acres**		
Athletics	N/A	0	**0**	
Other				
Corporation Yard	Academic/Admin	0	**0**	
TOTAL		**3,649,658**	**5,474,487**	

*Scenarios per data source "programmodel_09182019_DRAFT"

* LRDP Land Use designation by Brightworks building type was determined based off building data provided by UCR in the Brightworks analysis and the "Opportunity Site Potential List" for specific buildings. (See "Bldg. Summary" tab for compila

* 1 kbtu = 3.412 kWh

Interim Projects Construction Emissions (+)

Project	Construction Emissions	Start Year	End Year	Number of years of construction
North District Development (NDD) Phase 1	2241	2019	2021	3
North District Development (NDD) Phases 2-5	7280	2022	2025	4
Dundee Glasgow	e 2005 LRDP Amendment 2 EIR - no change in em	2018	2020	
The Barn	304	2018	2020	3
Plant Growth Environments Facility (PGEF)	264	2019	2020	2
Student Success Center (SSC)	493	2019	2021	3
Parking Structure 1 (PS1)	1849	2019	2021	3

Interim Emissions by Year	Construction
2018	101
2019	1761
2020	1761
2021	1528

	211,461,439	**110,552,995**	

ıg Operational Emissions (+) (UCR Adjusted Forecast)

Estimated Operational Energy Use for New Buildings			Energy Factors for LRDP Land Use	
Exceeding Code (New Building) EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTu/year)	Electricity (kWh/year)	Weighted LRDP Land Use EUI (kBTu/sf/yr.)	Natural Gas Usage (kBTU/sf/year)
39	1,035,275	2,730,794	96	35.3
136	5,403,923	2,187,151		
136	1,093,020	442,382		
136	15,258,751	6,175,735		
39	3,431,499	9,051,433	39	3.9
39	1,036,842	2,734,930		
39	362,770	956,897		
39	411,828	1,086,300		
34	36,725,652	20,894,189	39	12.7
88	1,329,042	1,108,634		
136	889,615	360,058		
88	3,099,096	2,585,142		
88	2,236,291	1,865,425		
	-	-		
65	-	-	39	4
	72,313,605	**52,179,069**		

ıtion of data

Construction Emissions per Year (MTCO2e)
747
1820

101.3333333
132
164.3333333
616.3333333

Electricity Usage (kWh/sf/year)
17.8
10.3
7.7
10

2022	1820
2023	1820
2024	1820
2025	1820
≥2026	0

Notes:
1) Operational emissions provided by UCR in the excel "UCR Interim Project" are those that include the amortized construction emissions. For the purposes of the inventory construction emissions and operational emissions are kept separate.

			Interim Projects Operational Emissions (+)	
			CalEEMod Emission Sources	
Project	Energy	Mobile	Area	Water
North District Development (NDD) Phase 1	2169	8,805	7	892
North District Development (NDD) Phases 2-5	7848	20573.00	22	2295
Dundee Glasgow	e 2005 LRDP Amendment 2 EIR - no change in emissions impact			
The Barn	184	0	0	0
Plant Growth Environments Facility (PGEF)	225	70	0	65
Student Success Center (SSC)	911	35	1	5
Parking Structure 1 (PS1)	462	0	0.1	0
Sum by Sector	11799	29483	30.1	3257

Operational Emissions by Year by Sector

Interim Emissions by Year	Energy	Mobile	Area	Water
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	409	70	0	65
2022	3951	8910	8	962
2023	3951	8910	8	962
2024	3951	8910	8	962
2025	3951	8910	8	962
≥2026	11799	29483	30	3257

Notes:
1) Operational emissions provided by UCR in the excel "UCR Interim Project" are those that include the amortized construction emissions. For the purposes of the inventory construction emissions and operational emissions are kept separate.
2) Operational emissions separated out to apply reduction measures to accordingly. CalEEMod Energy use is used in forecasting for interim proejcts however emissions assocaited with mobile, area, water, and waste are captured in the forecast

Interim Project Renovations[2]	Included in LRDP Baseline?	Gross Sqf	Land Use	Current Code EUI (Academic/Admin)
Batchelor Hall	Yes	106,249	Academics and Research	107
Pierce Hall	Yes	141,355	Academics and Research	107
Total		***247,604***		***107***

Notes:
1) Interim renovation projects did not have CalEEMod emission results available as they were analyzed under categorical exemption.

Waste	Total	Operational Year
61	11934	2022
276	31014	2026
	0	2021
14	198	2021
6	366	2021
9	961	2022
0	462.1	2022
366	44935.1	

Waste	Total
0	0
0	0
20	564
90	13921
90	13921
90	13921
90	13921
366	44935

through growth factors based on overall campus population growth.

Interim Projects Renovation Operational Emissions (+)[1]

Current Energy Usage		Estimated Energy Upgrades[3]	Estimated New Energy Use	
Natural Gas Usage (kBTu/year)	Electricity (kWh/year)		Natural Gas Usage (kBTu/year)	Electricity (kWh/year)
3,410,593	2,332,371	0.00%	3,410,592.90	2,332,371.07
4,537,496	3,103,016	16%	3,799,698.73	2,598,465.33
7,948,088	***5,435,387***		***7,210,292***	***4,930,836***

Net Energy Use	
Natural Gas Usage (therm/year)	Electricity (kWh/year)
-	-
(7,377.97)	(504,550.35)
(7,378)	***(504,550)***

2) Per 6.26.2020 email from UCR "Batchelor Hall and Pierce Hall renovation will include mechanical equipment system (e.g., HVAC) and electrical upgrades which would improve energy intensity. " Therefore, net new emissions from the renovat
3) Estimated improvement in EUI from the renovation energy upgrades was provided by UCR. Batchelor hall has not yet received approval to begin the project and it is currently uncertain which energy upgrade features will be included therefor
4) Net change in energy usage via natural gas or electricity is based on square footage of the building and EUI of building type as listed in the Brightworks Sustainability *UCR Program Concept Energy Analysis* .
5) 1 Kbtu = 0.0100 therm

ion project are based on improvements in building energy intensity (EUI) from the current building code, assumed to be 2016 -Title 24.
e it is conservatively assumed to have a 0% improvement in EUI.

Year	1990	2018	2020	2025	2030	2035	2040	2045	2050
Emissions (MT of CO2e)									
Business-as-usual (BAU)									
Electricity		45,834	54,759	87,284	122,028	156,320	156,320	156,320	156,320
Natural Gas		18,410	21,995	33,834	45,674	57,629	57,629	57,629	57,629
Other Fuels		82	98	138	178	218	218	218	218
Building and Facility Refrigerants		339	405	569	734	899	899	899	899
UCR Fleet (Unleaded)		1,200	1,269	1,440	1,611	1,782	1,782	1,782	1,782
UCR Fleet (Diesel)		29	31	35	39	44	44	44	44
UCR Fleet (CNG)		75	80	90	101	112	112	112	112
UCR Business Travel		1,562	1,671	1,943	2,215	2,487	2,487	2,487	2,487
On-Road Transportation (Passenger)		26,342	28,995	35,628	42,261	43,805	45,350	46,894	46,894
On-Road Transportation (Commercial/ Heavy Duty)		2,372	2,735	3,643	4,551	4,609	4,666	4,723	4,723
Public Transit		743	785	891	997	1,103	1,103	1,103	1,103
Waste		244	258	293	328	362	362	362	362
LRDP Demolition		0	0	44	44	44	0	0	0
LRDP Construction		0	0	1,055	1,055	1,055	0	0	0
Interim Project Construction		101	1,761	1,820	0	0	0	0	0
Interim Project Operation		0	0	3,717	10,631	9,463	8,295	7,128	5,960
Total		**97,333**	**114,841**	**172,425**	**232,446**	**279,931**	**279,266**	**279,700**	**278,532**
Legislative Adjusted (Leg Adj)									
Electricity		45,834	51,249	63,650	68,666	57,703	28,852	0	0
Natural Gas		18,410	21,995	32,526	43,056	53,702	53,702	53,702	53,702
Other Fuels		82	98	138	178	218	218	218	218
Building and Facility Refrigerants		339	405	569	734	899	899	899	899
UCR Fleet (Unleaded)		1,200	1,269	1,440	1,611	1,782	1,782	1,782	1,782
UCR Fleet (Diesel)		29	31	35	39	44	44	44	44
UCR Fleet (CNG)		75	80	90	101	112	112	112	112
UCR Business Travel		1,562	1,671	1,943	2,215	2,487	2,487	2,487	2,487
On-Road Transportation (Passenger)		26,342	28,926	29,684	30,324	29,423	28,381	28,757	28,506
On-Road Transportation (Commercial/ Heavy Duty)		2,372	2,566	3,121	3,624	3,135	2,630	3,305	3,282
Public Transit		743	714	608	453	251	0	0	0
Waste		244	258	293	328	362	362	362	362
LRDP Demolition		0	0	44	44	44	0	0	0
LRDP Construction		0	0	1,055	1,055	1,055	0	0	0
Interim Project Construction		101	1,761	1,820	0	0	0	0	0
Interim Project Operation		0	0	2,905	6,697	3,814	1,056	-1,701	-2,869
Total		**97,333**	**111,021**	**139,920**	**159,124**	**155,029**	**120,524**	**89,966**	**88,524**
				34,798	**45,719**	**56,756**	**56,756**	**56,756**	
Legislative Reductions									
SB 100		0	-3,510	-18,411	-42,916	-82,948	-111,800	-140,652	-140,652
Building Code		0	0	-6,532	-13,064	-19,595	-19,595	-19,595	-19,595
Tailpipe		0	-238	-6,466	-12,865	-15,856	-19,005	-19,555	-19,829
Innovative Clean Transit		0	-71	-284	-544	-852	-1,103	-1,103	-1,103
Total		**0**	**-3,820**	**-31,693**	**-69,388**	**-119,252**	**-151,504**	**-180,905**	**-181,180**

Activity Data & Emission Factors

Campus Population								
Student Population (SP)	23,922	25225	28484	31742	35,000	35,000	35,000	35,000
Faculty/Staff Population (FSP)	4,739	5069	5894	6720	7,545	7,545	7,545	7,545
Campus Population Total (CP)	28,661	30294	34378	38461	42,545	42,545	42,545	42,545
Campus Space (GSF)								
Academics & Research	1,220,283	1376871	1768339	2159808	2,551,277	2,551,277	2,551,277	2,551,277
Academic Support	1,458,975	1702955	2312906	2922856	3,532,806	3,532,806	3,532,806	3,532,806
Student Life	1,875,963	2396174	3696701	4997228	6,297,756	6,297,756	6,297,756	6,297,756
Other	248,279	262884	299395	335907	372,419	372,419	372,419	372,419
Campus LRDP Program Space Total	4,803,500	5738883	8077341	10415800	12,754,258	12,754,258	12,754,258	12,754,258
Electricity								
BAU Consumption (kWh)	118,960,675	142,125,831	226,544,239	316,721,169	405,726,534	405,726,534	405,726,534	405,726,534
Leg Adj Consumption (kWh)	118,960,675	142,125,831	212,988,450	289,609,592	365,059,169	365,059,169	365,059,169	365,059,169
Leg Adj Emission Factor (MT CO2e/MWh)	0.385284882	0.36058713	0.29884276	0.23709839	0.15806559	0.0790328	0	0
BAU Emissions Factor (MT CO2e/MWh)	0.385284882	0.38528488	0.38528488	0.38528488	0.38528488	0.38528488	0.38528488	0.38528488
Natural Gas								
BAU Consumption (Therms)	3,466,942	4,142,058	6,371,626	8,601,195	10,852,542	10,852,542	10,852,542	10,852,542
Leg Adj Consumption (Therms)	3,466,942	4,142,058	6,125,127	8,108,197	10,113,046	10,113,046	10,113,046	10,113,046
Other Stationary Combustion Fuels								
Diesel Consumption (gallons)	8,003	9,561	13,457	17,354	21,250	21,250	21,250	21,250
Fugitive Emissions								
Building and Facility Refrigerants (MT CO2e)	339	405	569	734	899	899	899	899
UCR Fleet								
Unleaded Gasoline Usage (gallons)	135,192	142,897	162,158	181,419	200,681	200,681	200,681	200,681
Diesel Usage (gallons)	7,306	7,722	8,763	9,804	10,845	10,845	10,845	10,845
CNG Usage (scf)	4,321	4,567	5,183	5,799	6,414	6,414	6,414	6,414
Business Travel								
Total Air Travel (passenger miles)	8,273,344	8,849,606	10,290,259	11,730,913	13,171,567	13,171,567	13,171,567	13,171,567
Emission Factor (MT CO2e/miles)	0	0	0	0	0	0	0	0
Waste								
Waste Landfilled (tons)	1,456	1,538	1,746	1,953	2,161	2,161	2,161	2,161

Transportation								
On-Road Passenger (VMT)	79,581,443	87,597,344	107,637,097	127,676,851	132,342,053	137,007,255	141,672,456	141,672,456
On-Road Passenger BAU Emission Factor (g CO2e/mile)	331.00	331.00	331.00	331.00	331.00	331.00	331.00	331.00
On-Road Passenger Adjusted Emission Factor (g CO2e/mile)	331.00	330.21	275.78	237.50	222.33	207.15	202.98	201.21
On-Road Light-Heavy (VMT)	607,005	703,384	944,330	1,185,276	1,224,441	1,263,606	1,302,770	1,302,770
On-Road Light-Heavy BAU Emission Factor (g CO2e/mile)	665.04	665.04	665.04	665.04	665.04	665.04	665.04	665.04
On-Road Light-Heavy Adjusted Emission Factor (g CO2e/mile)	665.04	642.80	603.47	558.03	533.31	508.59	498.66	492.99
On-Road Med-Heavy (VMT)	577,080	664,378	882,623	1,100,867	1,098,630	1,096,393	1,094,157	1,094,157
On-Road Med-Heavy BAU Emission Factor (g CO2e/mile)	1064.80	1064.80	1064.80	1064.80	1064.80	1064.80	1064.80	1064.80
On-Road Med-Heavy Adjusted Emission Factor (g CO2e/mile)	1064.80	997.60	883.86	820.59	784.40	748.21	731.20	721.93
On-Road Heavy-Heavy (VMT)	896,490	1,033,034	1,374,394	1,715,753	1,738,033	1,760,313	1,782,593	1,782,593
On-Road Heavy-Heavy BAU Emission Factor (g CO2e/mile)	1510.15	1510.15	1510.15	1510.15	1510.15	1510.15	1510.15	1510.15
On-Road Heavy-Heavy Adjusted Emission Factor (g CO2e/mile)	1510.15	1404.94	1234.56	1123.21	1927.48	2731.74	948.26	938.84
On-Road Commercial (VMT)	2,080,575	2,400,795	3,201,346	4,001,897	4,061,105	4,120,312	4,179,520	4,179,520
On-Road Commercial BAU Emission Factor (g CO2e/mile)	1140.06	1139.30	1138.07	1137.33	1134.86	1132.47	1130.14	1130.14
On-Road Commercial Adjusted Emission Factor (g CO2e/mile)	1140.06	1068.92	975.04	905.67	771.95	638.22	790.78	785.33
Public Transit								
Attributed Bus VMT (VMT)	407,912	431,159	489,276	547,393	605,509	605,509	605,509	605,509
Bus BAU Emission Factor (g CO2e/mile)	0.001821643	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164
Bus Adjusted Emission Factor (g CO2e/mile)	0.001821643	0.00165604	0.00124203	0.00082802	0.00041401	0	0	0

Year		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Summary																	
Business-as-usual (BAU) Forecast																	
Electricity		45,834	50,296	54,759	61,264	67,769	74,274	80,779	87,284	93,789	100,294	106,799	113,304	122,028	128,886	135,745	142,603
Natural Gas		18,410	20,203	21,995	24,363	26,731	29,099	31,467	33,834	36,202	38,570	40,938	43,306	45,674	48,065	50,456	52,847
Other Fuels		82	90	98	106	114	122	130	138	146	154	162	170	178	186	194	202
Building and Facility Refrigerants		339	372	405	438	470	503	536	569	602	635	668	701	734	767	800	833
UCR Fleet (Unleaded)		1,200	1,235	1,269	1,303	1,337	1,371	1,406	1,440	1,474	1,508	1,542	1,577	1,611	1,645	1,679	1,713
UCR Fleet (Diesel)		29	30	31	32	33	33	34	35	36	37	38	38	39	40	41	42
UCR Fleet (CNG)		75	78	80	82	84	86	88	90	93	95	97	99	101	103	105	108
UCR Business Travel		1,562	1,616	1,671	1,725	1,780	1,834	1,888	1,943	1,997	2,051	2,106	2,160	2,215	2,269	2,323	2,378
On-Road Transportation (Passenger)		26,342	27,668	28,995	30,322	31,648	32,975	34,301	35,628	36,955	38,281	39,608	40,935	42,261	42,570	42,879	43,188
On-Road Transportation (Commercial/ Heavy Duty)		2,372	2,554	2,735	2,917	3,098	3,280	3,462	3,643	3,825	4,007	4,188	4,370	4,551	4,563	4,574	4,586
Public Transit		743	764	785	807	828	849	870	891	912	934	955	976	997	1,018	1,040	1,061
Waste		244	251	258	265	272	279	286	293	300	307	314	321	328	334	341	348
LRDP Demolition		0	0	0	44	44	44	44	44	44	44	44	44	44	44	44	44
LRDP Construction		0	0	0	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055
Interim Project Construction		101	1,761	1,761	1,528	1,820	1,820	1,820	1,820	0	0	0	0	0	0	0	0
Interim Project Operation		0	0	0	175	3,717	3,717	3,717	3,717	11,565	11,332	11,098	10,865	10,631	10,398	10,164	9,930
Total		**97,333**	**106,917**	**114,841**	**126,423**	**140,799**	**151,341**	**161,883**	**172,425**	**188,995**	**199,303**	**209,611**	**219,919**	**232,446**	**241,943**	**251,440**	**260,937**
Legislative Adjusted Forecast (Leg Adj)																	
Electricity		45,834	48,684	51,249	54,429	57,259	59,740	61,870	63,650	65,080	66,160	66,890	67,271	68,666	67,428	65,712	63,519
Natural Gas		18,410	20,203	21,995	24,101	26,207	28,313	30,419	32,526	34,632	36,738	38,844	40,950	43,056	45,185	47,314	49,444
Other Fuels		82	90	98	106	114	122	130	138	146	154	162	170	178	186	194	202
Building and Facility Refrigerants		339	372	405	438	470	503	536	569	602	635	668	701	734	767	800	833
UCR Fleet (Unleaded)		1,200	1,235	1,269	1,303	1,337	1,371	1,406	1,440	1,474	1,508	1,542	1,577	1,611	1,645	1,679	1,713
UCR Fleet (Diesel)		29	30	31	32	33	33	34	35	36	37	38	38	39	40	41	42
UCR Fleet (CNG)		75	78	80	82	84	86	88	90	93	95	97	99	101	103	105	108
UCR Business Travel		1,562	1,616	1,671	1,725	1,780	1,834	1,888	1,943	1,997	2,051	2,106	2,160	2,215	2,269	2,323	2,378
On-Road Transportation (Passenger)		26,342	27,635	28,926	29,252	29,491	29,642	29,707	29,684	29,935	30,124	30,252	30,318	30,324	30,155	29,980	29,800
On-Road Transportation (Commercial/ Heavy Duty)		2,372	2,475	2,566	2,689	2,806	2,917	3,022	3,121	3,231	3,336	3,437	3,533	3,624	3,528	3,431	3,333
Public Transit		743	730	714	697	677	656	633	608	581	552	521	488	453	417	378	337
Waste		244	251	258	265	272	279	286	293	300	307	314	321	328	334	341	348
LRDP Demolition		0	0	0	44	44	44	44	44	44	44	44	44	44	44	44	44
LRDP Construction		0	0	0	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055
Interim Project Construction		101	1,761	1,761	1,528	1,820	1,820	1,820	1,820	0	0	0	0	0	0	0	0
Interim Project Operation		0	0	0	142	3,257	3,133	3,016	2,905	8,820	8,279	7,747	7,223	6,697	6,112	5,532	4,956
Total		**97,333**	**105,158**	**111,021**	**117,885**	**126,705**	**131,549**	**135,954**	**139,920**	**148,024**	**151,074**	**153,716**	**155,947**	**159,124**	**159,267**	**158,930**	**158,112**
Legislative Reductions																	
SB 100		0	-1,612	-3,510	-5,790	-8,420	-11,401	-14,731	-18,411	-22,441	-26,822	-31,552	-36,632	-42,916	-49,969	-57,498	-65,504
Building Code		0	0	0	-1,306	-2,613	-3,919	-5,225	-6,532	-7,838	-9,145	-10,451	-11,757	-13,064	-14,370	-15,676	-16,983
Tailpipe		0	-112	-238	-1,297	-2,449	-3,695	-5,034	-6,466	-7,614	-8,828	-10,108	-11,453	-12,865	-13,450	-14,042	-14,641
Innovative Clean Transit		0	-35	-71	-110	-151	-193	-237	-284	-332	-382	-434	-488	-544	-602	-662	-723
Total		**0**	**-1,759**	**-3,820**	**-8,504**	**-13,633**	**-19,208**	**-25,227**	**-31,693**	**-38,225**	**-45,176**	**-52,545**	**-60,331**	**-69,388**	**-78,391**	**-87,878**	**-97,851**
Adjusted - BAU (check)		0	-1,759	-3,820	-8,538	-14,094	-19,793	-25,929	-32,505	-40,971	-48,229	-55,896	-63,973	-73,323	-82,676	-92,510	-102,825
Growth Metrics																	
Demographics																	
Student Population (SP)		23,922	24574	25225	25877	26529	27180	27832	28484	29135	29787	30438	31090	31742	32393	33045	33697
Faculty/Staff Population (FSP)		4,739	4904	5069	5234	5399	5564	5729	5894	6059	6224	6389	6554	6720	6885	7050	7215
Campus Population Total (CP)		28661	29478	30294	31111	31928	32744	33561	34378	35195	36011	36828	37645	38461	39278	40095	40911
Campus Space (GSF)																	
Academics & Research		1,220,283	1298577	1376871	1455164	1533458	1611752	1690046	1768339	1846633	1924927	2003221	2081515	2159808	2238102	2316396	2394690
Academic Support		1,458,975	1580965	1702955	1824945	1946935	2068925	2190915	2312906	2434896	2556886	2678876	2800866	2922856	3044846	3166836	3288826
Student Life		1,875,963	2136068	2396174	2656279	2916385	3176490	3436596	3696701	3956807	4216912	4477018	4737123	4997228	5257334	5517439	5777545
Other		248,279	255581	262884	270186	277488	284791	292093	299395	306698	314000	321302	328605	335907	343209	350512	357814
Campus LRDP Program Space Total		4,803,500	5271192	5738883	6206575	6674267	7141958	7609650	8077341	8545033	9012725	9480416	9948108	10415800	10883491	11351183	11818875
Yearly % Increase Campus Pop			3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly % Increase Campus Space			10%	9%	8%	8%	7%	7%	6%	6%	5%	5%	5%	5%	4%	4%	4%
BAU Forecast																	
Building and Facility Energy Usage (BAU)																	
Natural Gas Use per Square Foot (therm/sqf)		0.721753277	0.721753277	0.721753277	0.721753277	0.721753277	0.721753277	0.721753277	0.721753277	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328
Baseline Natural Gas Usage (therms)		3,466,942	3,804,500	4,142,058	4,479,616	4,817,174	5,154,732	5,492,290	5,829,848	6,167,406	6,504,964	6,842,522	7,180,080	7,517,637	7,855,195	8,192,753	8,530,311
Natural Gas Usage of Demoed Buildings (therms)	subtract out			0	32,619	65,237	97,856	130,474	163,093	195,711	228,330	260,949	293,567	326,186	354,449	382,711	410,974
BAU Natural Gas Usage of New Buildings (therms)	add in			0	140,974	281,949	422,923	563,897	704,871	845,846	986,820	1,127,794	1,268,769	1,409,743	1,550,717	1,691,692	1,832,666
BAU Natural Gas Consumption (Therms)		3,466,942	3,804,500	4,142,058	4,587,971	5,033,885	5,479,799	5,925,713	6,371,626	6,817,540	7,263,454	7,709,367	8,155,281	8,601,195	9,051,464	9,501,734	9,952,003
NG Factor (MT CO2e/therm)		0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018
Natural Gas Emissions (MT CO2e)		18,410	20,203	21,995	24,363	26,731	29,099	31,467	33,834	36,202	38,570	40,938	43,306	45,674	48,065	50,456	52,847
Diesel Use per Square Foot (gallons/sqf)		0.001666077	0.001666077	0.001666077	0.001666077	0.001666077	0.001666077	0.001666077	0.001666077	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608
Total Diesel Usage (gallons)		8,003	8,782	9,561	10,341	11,120	11,899	12,678	13,457	14,237	15,016	15,795	16,574	17,354	18,133	18,912	19,691
BAU Factor (MT CO2e/gallons)		0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268
Diesel Emissions (MT CO2e)		81.97216804	89.95336866	97.93456929	105.9157699	113.8969705	121.8781712	129.8593718	137.8405724	145.821773	153.802974	161.784174	169.765375	177.746576	185.727776	193.708977	201.690177
Electricity Use per Square Foot (kWh/sqf)		24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584
Baseline Electricity Use (kWh)		118,960,675	130,543,253	142,125,831	153,708,408	165,290,986	176,873,564	188,456,142	200,038,720	211,621,297	223,203,875	234,786,453	246,369,031	257,951,609	269,534,186	281,116,764	292,699,342
Electricity Usage of Demoed Buildings (kWh)	subtract out			0	2,069,096	4,138,192	6,207,287	8,276,383	10,345,479	12,414,575	14,483,671	16,552,766	18,621,862	14,932,436	16,084,140	17,235,845	18,387,549
BAU Electricity Usage of New Buildings (kWh)	add in			0	7,370,200	14,740,399	22,110,599	29,480,799	36,850,998	44,221,198	51,591,398	58,961,597	66,331,797	73,701,997	81,072,196	88,442,396	95,812,596
BAU electricity Consumption (kWh)		118,960,675	130,543,253	142,125,831	159,009,512	175,893,194	192,776,876	209,660,557	226,544,239	243,427,921	260,311,602	277,195,284	294,078,966	316,721,169	334,522,242	352,323,315	370,124,388
BAU Factor (MT CO2e/kWh)		0.000385285	0.000385285	0.000385285	0.000385285	0.000385285	0.000385285	0.000385285	0.000385285	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528
Electricity Emissions (MT CO2e)		45,834	50,296	54,759	61,264	67,769	74,274	80,779	87,284	93,789	100,294	106,799	113,304	122,028	128,886	135,745	142,603
Building and Facility Refrigerant Usage (BAU)																	
Refrigerant Usage per Square Footage (MT CO2e/sqf)		7.04917E-05	7.04917E-05	7.04917E-05	7.04917E-05	7.04917E-05	7.04917E-05	7.04917E-05	7.04917E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05
Refrigerant Emissions (MT CO2e)		339	372	405	438	470	503	536	569	602	635	668	701	734	767	800	833
UCR Fleet (BAU)																	
Unleaded Gasoline Usage (gallons per Campus Pop)		4.716932417	4.716932417	4.716932417	4.716932417	4.716932417	4.716932417	4.716932417	4.716932417	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242
Diesel Usage (gallons per Campus Pop)		0.254910854	0.254910854	0.254910854	0.254910854	0.254910854	0.254910854	0.254910854	0.254910854	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085
CNG Usage (scf per Campus Pop)		0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236
Unleaded Gasoline Usage (gallons)		135,192	139,044	142,897	146,749	150,601	154,453	158,306	162,158	166,010	169,862	173,715	177,567	181,419	185,271	189,124	192,976
Diesel Usage (gallons)		7,306	7,514	7,722	7,931	8,139	8,347	8,555	8,763	8,971	9,180	9,388	9,596	9,804	10,012	10,221	10,429
CNG Usage (scf)		4,321	4,444	4,567	4,690	4,814	4,937	5,060	5,183	5,306	5,429	5,552	5,675	5,799	5,922	6,045	6,168
BAU Unleaded Gasoline Factor (MT CO2e/gallon)		0.008878852	0.008878852	0.008878852	0.008878852	0.008878852	0.008878852	0.008878852	0.008878852	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885
BAU Diesel Factor (MT CO2e/gallon)		0.004011471	0.004011471	0.004011471	0.004011471	0.004011471	0.004011471	0.004011471	0.004011471	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147
BAU CNG Factor(MT CO2e/scf)		0.017445708	0.017445708	0.017445708	0.017445708	0.017445708	0.017445708	0.017445708	0.017445708	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Summary																	
Business-as-usual (BAU) Forecast																	
Electricity	149,462	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320
Natural Gas	55,238	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629
Other Fuels	210	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
Building and Facility Refrigerants	866	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899
UCR Fleet (Unleaded)	1,748	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
UCR Fleet (Diesel)	43	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
UCR Fleet (CNG)	110	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112
UCR Business Travel	2,432	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487
On-Road Transportation (Passenger)	43,497	43,805	44,114	44,423	44,732	45,041	45,350	45,658	45,967	46,276	46,585	46,894	46,894	46,894	46,894	46,894	46,894
On-Road Transportation (Commercial/ Heavy Duty)	4,597	4,609	4,620	4,632	4,643	4,655	4,666	4,678	4,689	4,700	4,712	4,723	4,723	4,723	4,723	4,723	4,723
Public Transit	1,082	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103
Waste	355	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362
LRDP Demolition	44	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LRDP Construction	1,055	1,055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Project Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Project Operation	9,697	9,463	9,230	8,996	8,763	8,529	8,295	8,062	7,828	7,595	7,361	7,128	6,894	6,660	6,427	6,193	5,960
Total	**270,434**	**279,931**	**278,919**	**279,006**	**279,093**	**279,180**	**279,266**	**279,353**	**279,440**	**279,526**	**279,613**	**279,700**	**279,466**	**279,233**	**278,999**	**278,766**	**278,532**
Legislative Adjusted Forecast (Leg Adj)																	
Electricity	60,850	57,703	51,933	46,163	40,392	34,622	28,852	23,081	17,311	11,541	5,770	0	0	0	0	0	0
Natural Gas	51,573	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702
Other Fuels	210	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
Building and Facility Refrigerants	866	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899
UCR Fleet (Unleaded)	1,748	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
UCR Fleet (Diesel)	43	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
UCR Fleet (CNG)	110	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112
UCR Business Travel	2,432	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487
On-Road Transportation (Passenger)	29,615	29,423	29,226	29,023	28,815	28,601	28,381	28,459	28,536	28,611	28,685	28,757	28,707	28,657	28,606	28,556	28,506
On-Road Transportation (Commercial/ Heavy Duty)	3,234	3,135	3,035	2,935	2,834	2,732	2,630	2,763	2,898	3,033	3,169	3,305	3,301	3,296	3,291	3,287	3,282
Public Transit	295	251	201	150	100	50	0	0	0	0	0	0	0	0	0	0	0
Waste	355	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362
LRDP Demolition	44	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LRDP Construction	1,055	1,055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Project Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Project Operation	4,383	3,814	3,262	2,711	2,159	1,608	1,056	505	-46	-598	-1,149	-1,701	-1,934	-2,168	-2,402	-2,635	-2,869
Total	**156,811**	**155,029**	**147,262**	**140,587**	**133,905**	**127,218**	**120,524**	**114,414**	**108,303**	**102,192**	**96,079**	**89,966**	**89,678**	**89,389**	**89,101**	**88,812**	**88,524**
Legislative Reductions																	
SB 100	-73,988	-82,948	-88,719	-94,489	-100,259	-106,030	-111,800	-117,570	-123,341	-129,111	-134,881	-140,652	-140,652	-140,652	-140,652	-140,652	-140,652
Building Code	-18,289	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595
Tailpipe	-15,245	-15,856	-16,473	-17,097	-17,727	-18,363	-19,005	-19,113	-19,223	-19,333	-19,443	-19,555	-19,610	-19,665	-19,720	-19,775	-19,829
Innovative Clean Transit	-787	-852	-902	-953	-1,003	-1,053	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103
Total	**-108,309**	**-119,252**	**-125,690**	**-132,134**	**-138,584**	**-145,041**	**-151,504**	**-157,382**	**-163,262**	**-169,142**	**-175,023**	**-180,905**	**-180,960**	**-181,015**	**-181,070**	**-181,125**	**-181,180**
Adjusted - BAU (check)	-113,623	-124,902	-131,657	-138,419	-145,187	-151,962	-158,743	-164,939	-171,137	-177,335	-183,534	-189,734	-189,788	-189,843	-189,898	-189,953	-190,008
Growth Metrics																	
Demographics																	
Student Population (SP)	34348	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Faculty/Staff Population (FSP)	7380	7545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545
Campus Population Total (CP)	41728	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545	42,545
Campus Space (GSF)																	
Academics & Research	2472983	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277	2,551,277
Academic Support	3410816	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806	3,532,806
Student Life	6037650	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756	6,297,756
Other	365116	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419	372,419
Campus LRDP Program Space Total	12286566	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258	12,754,258
Yearly % Increase Campus Pop	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yearly % Increase Campus Space	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
BAU Forecast																	
Building and Facility Energy Usage (BAU)																	
Natural Gas Use per Square Foot (therm/sqf)	0.721753277	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328	0.72175328
Baseline Natural Gas Usage (therms)	8,867,869	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427
Natural Gas Usage of Demoed Buildings (therms)	439,237	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500
BAU Natural Gas Usage of New Buildings (therms)	1,973,640	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614	2,114,614
BAU Natural Gas Consumption (Therms)	10,402,273	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542	10,852,542
NG Factor (MT CO2e/therm)	0.005310176	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018
Natural Gas Emissions (MT CO2e)	55,238	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629	57,629
Diesel Use per Square Foot (gallons/sqf)	0.001666077	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608	0.00166608
Total Diesel Usage (gallons)	20,470	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250
BAU Factor (MT CO2e/gallons)	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268	0.01024268
Diesel Emissions (MT CO2e)	209.671378	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579	217.652579
Electricity Use per Square Foot (kWh/sqf)	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584	24.76541584
Baseline Electricity Use (kWh)	304,281,920	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498
Electricity Usage of Demoed Buildings (kWh)	19,539,254	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958
BAU Electricity Usage of New Buildings (kWh)	103,182,795	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995	110,552,995
BAU electricity Consumption (kWh)	387,925,461	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534	405,726,534
BAU Factor (MT CO2e/kWh)	0.000385285	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528	0.00038528
Electricity Emissions (MT CO2e)	149,462	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320	156,320
Building and Facility Refrigerant Usage (BAU)																	
Refrigerant Usage per Square Footage (MT CO2e/sqf)	7.04917E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05	7.0492E-05
Refrigerant Emissions (MT CO2e)	866	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899	899
UCR Fleet (BAU)																	
Unleaded Gasoline Usage (gallons per Campus Pop)	4.716932417	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242	4.71693242
Diesel Usage (gallons per Campus Pop)	0.254910854	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085	0.25491085
CNG Usage (scf per Campus Pop)	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236	0.15076236
Unleaded Gasoline Usage (gallons)	196,828	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681	200,681
Diesel Usage (gallons)	10,637	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845	10,845
CNG Usage (scf)	6,291	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414	6,414
BAU Unleaded Gasoline Factor (MT CO2e/gallon)	0.008878852	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885	0.00887885
BAU Diesel Factor (MT CO2e/gallon)	0.004011471	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147	0.00401147
BAU CNG Factor(MT CO2e/scf)	0.017445708	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571	0.01744571

Unleaded Gasoline Emissions (MT CO2e)	1,200	1,235	1,269	1,303	1,337	1,371	1,406	1,440	1,474	1,508	1,542	1,577	1,611	1,645	1,679	1,713	1,748	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
Diesel Emissions (MT CO2e)	29	30	31	32	33	33	34	35	36	37	38	38	39	40	41	42	43	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
CNG Emissions (MT CO2e)	75	78	80	82	84	86	88	90	93	95	97	99	101	103	105	108	110	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112
Total Fleet Emissions (MT CO2e)	1,305	1,342	1,379	1,417	1,454	1,491	1,528	1,565	1,603	1,640	1,677	1,714	1,751	1,788	1,826	1,863	1,900	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937	1,937

UCR Business Travel (BAU)

Air Travel (passenger miles per faculty/staff)	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746
Total Air Travel (passenger miles)	8,273,344	8,561,475	8,849,606	9,137,736	9,425,867	9,713,998	10,002,129	10,290,259	10,578,390	10,866,521	11,154,652	11,442,782	11,730,913	12,019,044	12,307,175	12,595,306	12,883,436	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567	13,171,567
BAU Factor (MT CO2e/miles)	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879	0.00018879
Air Travel Emissions (MT CO2e)	1,562	1,616	1,671	1,725	1,780	1,834	1,888	1,943	1,997	2,051	2,106	2,160	2,215	2,269	2,323	2,378	2,432	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487	2,487

On-road Transportation (BAU)

Passenger VMT/year	79,581,443	83,589,393	87,597,344	91,605,295	95,613,245	99,621,196	103,629,147	107,637,097	111,645,048	115,652,999	119,660,950	123,668,900	127,676,851	128,609,891	129,542,932	130,475,972	131,409,012	132,342,053	133,275,093	134,208,133	135,141,174	136,074,214	137,007,255	137,940,295	138,873,335	139,806,376	140,739,416	141,672,456	141,672,456	141,672,456	141,672,456	141,672,456	141,672,456
Light-Heavy VMT/year	607,005	655,194	703,384	751,573	799,762	847,951	896,141	944,330	992,519	1,040,709	1,088,898	1,137,087	1,185,276	1,193,109	1,200,942	1,208,775	1,216,608	1,224,441	1,232,274	1,240,107	1,247,940	1,255,773	1,263,606	1,271,438	1,279,271	1,287,104	1,294,937	1,302,770	1,302,770	1,302,770	1,302,770	1,302,770	1,302,770
Medium-Heavy VMT/year	577,080	620,729	664,378	708,027	751,676	795,325	838,974	882,623	926,271	969,920	1,013,569	1,057,218	1,100,867	1,100,420	1,099,972	1,099,525	1,099,078	1,098,630	1,098,183	1,097,736	1,097,288	1,096,841	1,096,393	1,095,946	1,095,499	1,095,051	1,094,604	1,094,157	1,094,157	1,094,157	1,094,157	1,094,157	1,094,157
Heavy-Heavy VMT/year	896,490	964,762	1,033,034	1,101,306	1,169,578	1,237,850	1,306,122	1,374,394	1,442,666	1,510,937	1,579,209	1,647,481	1,715,753	1,720,209	1,724,665	1,729,121	1,733,577	1,738,033	1,742,489	1,746,945	1,751,401	1,755,857	1,760,313	1,764,769	1,769,225	1,773,681	1,778,137	1,782,593	1,782,593	1,782,593	1,782,593	1,782,593	1,782,593
Commercial VMT/year	2,080,575	2,240,685	2,400,795	2,560,905	2,721,016	2,881,126	3,041,236	3,201,346	3,361,456	3,521,566	3,681,677	3,841,787	4,001,897	4,013,738	4,025,580	4,037,422	4,049,263	4,061,105	4,072,946	4,084,788	4,096,629	4,108,471	4,120,312	4,132,154	4,143,995	4,155,837	4,167,678	4,179,520	4,179,520	4,179,520	4,179,520	4,179,520	4,179,520
Passenger Emission Factor BAU (g CO2e/mile)	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002	331.002
Light-Heavy Emission Factor BAU (g CO2e/mile)	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035	665.035
Medium-Heavy Emission Factor BAU (g CO2e/mile)	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803	1,064.803
Heavy-Heavy Emission Factor BAU (g CO2e/mile)	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146	1,510.146
Commercial Emission Factor BAU (g CO2e/mile)	1,140.063	1,139.657	1,139.305	1,138.997	1,138.725	1,138.484	1,138.268	1,138.073	1,137.897	1,137.737	1,137.591	1,137.457	1,137.334	1,136.834	1,136.338	1,135.844	1,135.353	1,134.865	1,134.379	1,133.897	1,133.417	1,132.940	1,132.466	1,131.995	1,131.526	1,131.060	1,130.596	1,130.136	1,130.136	1,130.136	1,130.136	1,130.136	1,130.136
Passenger Emissions BAU (MT CO2e)	26,342	27,668	28,995	30,322	31,648	32,975	34,301	35,628	36,955	38,281	39,608	40,935	42,261	42,570	42,879	43,188	43,497	43,805	44,114	44,423	44,732	45,041	45,350	45,658	45,967	46,276	46,585	46,894	46,894	46,894	46,894	46,894	46,894
Light-Heavy Emissions BAU (MT CO2e)	404	436	468	500	532	564	596	628	660	692	724	756	788	793	799	804	809	814	820	825	830	835	840	846	851	856	861	866	866	866	866	866	866
Medium-Heavy Emissions BAU (MT CO2e)	614	661	707	754	800	847	893	940	986	1,033	1,079	1,126	1,172	1,172	1,171	1,171	1,170	1,170	1,169	1,169	1,168	1,168	1,167	1,167	1,166	1,166	1,166	1,165	1,165	1,165	1,165	1,165	1,165
Heavy-Heavy Emissions BAU (MT CO2e)	1,354	1,457	1,560	1,663	1,766	1,869	1,972	2,076	2,179	2,282	2,385	2,488	2,591	2,598	2,604	2,611	2,618	2,625	2,631	2,638	2,645	2,652	2,658	2,665	2,672	2,679	2,685	2,692	2,692	2,692	2,692	2,692	2,692
Commercial Emissions BAU (MT CO2e)	2,372	2,554	2,735	2,917	3,098	3,280	3,462	3,643	3,825	4,007	4,188	4,370	4,551	4,563	4,574	4,586	4,597	4,609	4,620	4,632	4,643	4,655	4,666	4,678	4,689	4,700	4,712	4,723	4,723	4,723	4,723	4,723	4,723

Public Transit (BAU)

Bus VMT per campus population	14.23230457	14.23230457	14.23230457	14.23230457	14.23230457	14.23230457	14.23230457	14.23230457	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.23230457	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046	14.2323046
Total Bus VMT	407,912	419,535	431,159	442,782	454,406	466,029	477,652	489,276	500,899	512,522	524,146	535,769	547,393	559,016	570,639	582,263	593,886	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509
Bus Emission Factor (MT CO2e/mile)	0.001821643	0.001821643	0.001821643	0.001821643	0.001821643	0.001821643	0.001821643	0.001821643	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.001821643	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164	0.00182164
Bus Emissions (MT CO2e)	743	764	785	807	828	849	870	891	912	934	955	976	997	1,018	1,040	1,061	1,082	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103

Waste (BAU)

Waste (tons/per campus population)	0.050783294	0.050783294	0.050783294	0.050783294	0.050783294	0.050783294	0.050783294	0.050783294	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.050783294	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329	0.05078329
Total waste (tons)	1,456	1,497	1,538	1,580	1,621	1,663	1,704	1,746	1,787	1,829	1,870	1,912	1,953	1,995	2,036	2,078	2,119	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161	2,161
Waste Emissions BAU (MT CO2e/ton)	0.167693434	0.167693434	0.167693434	0.167693434	0.167693434	0.167693434	0.167693434	0.167693434	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.167693434	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343	0.16769343
Waste Emissions BAU (MT CO2e)	244	251	258	265	272	279	286	293	300	307	314	321	328	334	341	348	355	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362

Construction & Demolition (BAU)

Building Demolition (sqf)	0	0	0	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	63,234	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Building Demolition (MT CO2e)	0	0	0	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Building Construction (sqf)	0	0	0	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	391,035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Building Construction (MT CO2e)	0	0	0	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	1,055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Building Construction (MT CO2e)	101	1,761	1,761	1,528	1,820	1,820	1,820	1,820	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interim Project Operation (MT CO2e)	-	-	-	175	3,717	3,717	3,717	3,717	11,565	11,332	11,098	10,865	10,631	10,398	10,164	9,930	9,697	9,463	9,230	8,996	8,763	8,529	8,295	8,062	7,828	7,595	7,361	7,128	6,894	6,660	6,427	6,193	5,960

Legislative Adjusted Forecast (Leg Adj)

Building and Facility Energy Usage (Adjusted)

Baseline Natural Gas Usage (therms)		3,466,942	3,804,500	4,142,058	4,479,616	4,817,174	5,154,732	5,492,290	5,829,848	6,167,406	6,504,964	6,842,522	7,180,080	7,517,637	7,855,195	8,192,753	8,530,311	8,867,869	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427	9,205,427
Natural Gas Usage of Demoed Buildings (therms)	subtract out			0	32,619	65,237	97,856	130,474	163,093	195,711	228,330	260,949	293,567	326,186	354,449	382,711	410,974	439,237	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500	467,500
Natural Gas Usage of New Buildings (therms)	add in			0	91,675	183,349	275,024	366,698	458,373	550,047	641,722	733,396	825,071	916,745	1,008,420	1,100,094	1,191,769	1,283,443	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118	1,375,118
Leg Adj Natural Gas Consumption (therms)		3,466,942	3,804,500	4,142,058	4,538,672	4,935,286	5,331,900	5,728,513	6,125,127	6,521,741	6,918,355	7,314,969	7,711,583	8,108,197	8,509,167	8,910,136	9,311,106	9,712,076	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046	10,113,046
NG Emission Factor (MT CO2e/therm)		0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.005310176	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.005310176	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018	0.00531018
Natural Gas Emissions (MT CO2e)		18,410	20,203	21,995	24,101	26,207	28,313	30,419	32,526	34,632	36,738	38,844	40,950	43,056	45,185	47,314	49,444	51,573	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702	53,702
BAU Diesel Emissions (MT CO2e)		82	90	98	106	114	122	130	138	146	154	162	170	178	186	194	202	210	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
RPU Electricity Leg Adj Emission Factor (MT Co2e/MWh)		0.428	0.41	0.40	0.39	0.37	0.36	0.35	0.33	0.32	0.30	0.29	0.28	0.263	0.25	0.23	0.21	0.19	0.18	0.16	0.14	0.12	0.11	0.09	0.07	0.05	0.04	0.02	0.000	0.000	0.000	0.000	0.000	0.000
RPU RPS		35%	37%	39%	41%	43%	45%	48%	50%	52%	54%	56%	58%	60%	63%	65%	68%	71%	73%	76%	79%	81%	84%	87%	89%	92%	95%	97%	100%	100%	100%	100%	100%	100%
RPU % of electricity supplied (baseline)		90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Campus Leg Adj Electricity Emission Factor (MT CO2e/MWh)		0.385	0.373	0.361	0.348	0.336	0.324	0.311	0.299	0.286	0.274	0.262	0.249	0.237	0.221	0.205	0.190	0.174	0.158	0.142	0.126	0.111	0.095	0.079	0.063	0.047	0.032	0.016	0.000	0.000	0.000	0.000	0.000	0.000
Baseline Electricity Use (kWh)		118,960,675	130,543,253	142,125,831	153,708,408	165,290,986	176,873,564	188,456,142	200,038,720	211,621,297	223,203,875	234,786,453	246,369,031	257,951,609	269,534,186	281,116,764	292,699,342	304,281,920	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498	315,864,498
Electricity Usage of Demoed Buildings (kWh)	subtract out			0	2,069,096	4,138,192	6,207,287	8,276,383	10,345,479	12,414,575	14,483,671	16,552,766	18,621,862	14,932,436	16,084,140	17,235,845	18,387,549	19,539,254	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958	20,690,958
Electricity Usage of New Buildings (kWh)	add in			0	4,659,042	9,318,084	13,977,126	18,636,168	23,295,210	27,954,252	32,613,294	37,272,336	41,931,378	46,590,420	51,249,462	55,908,504	60,567,546	65,226,588	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630	69,885,630
Leg Adj Electricity Use (kWh)		118,960,675	130,543,253	142,125,831	156,298,355	170,470,879	184,643,402	198,815,926	212,988,450	227,160,974	241,333,498	255,506,022	269,678,546	289,609,592	304,699,508	319,789,423	334,879,338	349,969,254	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169	365,059,169
Leg Adj Electricity Emissions (MT CO2e)		45,834	48,684	51,249	54,429	57,259	59,740	61,870	63,650	65,080	66,160	66,890	67,271	68,666	67,428	65,712	63,519	60,850	57,703	51,933	46,163	40,392	34,622	28,852	23,081	17,311	11,541	5,770	0	0	0	0	0	0
Legislative Reduction SB100 (MT CO2e)		0	-1,612	-3,510	-5,790	-8,420	-11,401	-14,731	-18,411	-22,441	-26,822	-31,552	-36,632	-42,916	-49,969	-57,498	-65,504	-73,988	-82,948	-88,719	-94,489	-100,259	-106,030	-111,800	-117,570	-123,341	-129,111	-134,881	-140,652	-140,652	-140,652	-140,652	-140,652	-140,652
Legislative Reduction Building Code Electricity (MT CO2e)		0	0	0	-1,045	-2,089	-3,134	-4,178	-5,223	-6,267	-7,312	-8,357	-9,401	-10,446	-11,490	-12,535	-13,579	-14,624	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669	-15,669
Legislative Reduction Building Code Natural Gas (MT CO2e)		0	0	0	-262	-524	-785	-1,047	-1,309	-1,571	-1,833	-2,094	-2,356	-2,618	-2,880	-3,141	-3,403	-3,665	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927	-3,927
Combined building Code Reductions (Mt CO2e)		0	0	0	-1,306	-2,613	-3,919	-5,225	-6,532	-7,838	-9,145	-10,451	-11,757	-13,064	-14,370	-15,676	-16,983	-18,289	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595	-19,595
Combined Energy Legislative Reductions (MT CO2e)		0	-1,612	-3,510	-7,097	-11,033	-15,320	-19,956	-24,943	-30,280	-35,966	-42,003	-48,390	-55,980	-64,339	-73,174	-82,487	-92,277	-102,544	-108,314	-114,085	-119,855	-125,625	-131,396	-137,166	-142,936	-148,706	-154,477	-160,247	-160,247	-160,247	-160,247	-160,247	-160,247
Leg Adj-BAU (check)		0	-1,612	-3,510	-7,097	-11,033	-15,320	-19,956	-24,943	-30,280	-35,966	-42,003	-48,390	-55,980	-64,339	-73,174	-82,487	-92,277	-102,544	-108,314	-114,085	-119,855	-125,625	-131,396	-137,166	-142,936	-148,706	-154,477	-160,247	-160,247	-160,247	-160,247	-160,247	-160,247
		0%	2%	5%	8%	12%	15%	18%	21%	23%	26%	28%	31%	33%	36%	39%	42%	45%	48%	51%	53%	56%	59%	61%	64%	67%	69%	72%	75%	75%	75%	75%	75%	75%
		0%	3%	6%	9%	12%	15%	18%	21%	24%	27%	30%	32%	35%	39%	42%	46%	50%	53%	57%	60%	64%	68%	72%	75%	79%	83%	86%	90%	90%	90%	90%	90%	90%

Leg Adj On-road Transportation

Passenger Emission Factor Leg Adj (g CO2e/mile)	331.002	330.607	330.212	319.325	308.439	297.552	286.665	275.779	268.124	260.469	252.814	245.158	237.503	234.468	231.432	228.397	225.362	222.326	219.291	216.255	213.220	210.184	207.149	206.316	205.483	204.650	203.817	202.984	202.628	202.273	201.918	201.563	201.207
Light-Heavy Emission Factor Leg Adj (g CO2e/mile)	665.035	653.915	642.795	634.931	627.067	619.202	611.338	603.474	594.386	585.297	576.209	567.121	558.033	553.089	548.144	543.200	538.256	533.312	528.367	523.423	518.479	513.535	508.590	506.605	504.620	502.635	500.649	498.664	497.528	496.393	495.257	494.121	492.985
Medium-Heavy Emission Factor Leg Adj (g CO2e/mile)	1,064.803	1,031.199	997.596	974.848	952.100	929.352	906.604	883.856	871.203	858.551	845.898	833.245	820.592	813.354	806.115	798.877	791.638	784.399	777.161	769.922	762.684	755.445	748.206	744.805	741.404	738.003	734.602	731.201	729.347	727.493	725.639	723.785	721.931
Heavy-Heavy Emission Factor Leg Adj (g CO2e/mile)	1,510.146	1,457.541	1,404.937	1,370.862	1,336.787	1,302.713	1,268.638	1,234.563	1,212.292	1,190.021	1,167.750	1,145.479	1,123.208	1,284.062	1,444.915	1,605.769	1,766.623	1,927.476	2,088.330	2,249.183	2,410.037	2,570.890	2,731.744	2,375.047	2,018.351	1,661.655	1,304.958	948.262	946.377	944.492	942.608	940.723	938.838
Commercial Emission Factor Leg Adj (g CO2e/mile)	1,140.063	1,104.492	1,068.920	1,050.145	1,031.369	1,012.594	993.818	975.043	961.169	947.295	933.421	919.547	905.673	878.927	852.182	825.437	798.691	771.946	745.201	718.455	691.710	664.965	638.219	668.730	699.242	729.753	760.264	790.776	789.687	788.599	787.511	786.423	785.335
Passenger Emissions Leg Adj (MT CO2e)	26,342	27,635	28,926	29,252	29,491	29,642	29,707	29,684	29,935	30,124	30,252	30,318	30,324	30,155	29,980	29,800	29,615	29,423	29,226	29,023	28,815	28,601	28,381	28,459	28,536	28,611	28,685	28,757	28,707	28,657	28,606	28,556	28,506
Light-Heavy Emissions Leg Adj (MT CO2e)	404	428	452	477	502	525	548	570	590	609	627	645	661	660	658	657	655	653	651	649	647	645	643	644	646	647	648	650	648	647	645	644	642
Medium-Heavy Emissions Leg Adj (MT CO2e)	614	640	663	690	716	739	761	780	807	833	857	881	903	895	887	878	870	862	853	845	837	829	820	816	812	808	804	800	798	796	794	792	790
Heavy-Heavy Emissions Leg Adj (MT CO2e)	1,354	1,406	1,451	1,510	1,563	1,613	1,657	1,697	1,749	1,798	1,844	1,887	1,927	2,209	2,492	2,777	3,063	3,350	3,639	3,929	4,221	4,514	4,809	4,191	3,571	2,947	2,320	1,690	1,687	1,684	1,680	1,677	1,674
Commercial Emissions Leg Adj (MT CO2e)	2,372	2,475	2,566	2,689	2,806	2,917	3,022	3,121	3,231	3,336	3,437	3,533	3,624	3,528	3,431	3,333	3,234	3,135	3,035	2,935	2,834	2,732	2,630	2,763	2,898	3,033	3,169	3,305	3,301	3,296	3,291	3,287	3,282
Legislative Reductions Passenger Emissions (MT CO2e)	0	-33	-69	-1,070	-2,157	-3,332	-4,595	-5,944	-7,020	-8,157	-9,356	-10,616	-11,938	-12,415	-12,898	-13,387	-13,882	-14,382	-14,888	-15,400	-15,917	-16,440	-16,969	-17,199	-17,431	-17,665	-17,900	-18,137	-18,187	-18,237	-18,288	-18,338	-18,388
Legislative Reductions Light-Heavy Emissions (MT CO2e)	0	-7	-16	-23	-30	-39	-48	-58	-70	-83	-97	-111	-127	-134	-140	-147	-154	-161	-168	-176	-183	-190	-198	-201	-205	-209	-213	-217	-218	-220	-221	-223	-224
Legislative Reductions Medium-Heavy Emissions (MT CO2e)	0	-21	-45	-64	-85	-108	-133	-160	-179	-200	-222	-245	-269	-277	-285	-292	-300	-308	-316	-324	-332	-339	-347	-351	-354	-358	-361	-365	-367	-369	-371	-373	-375
Legislative Reductions Heavy-Heavy Emissions (MT CO2e)	0	-51	-109	-153	-203	-257	-315	-379	-430	-484	-541	-601	-664	-389	-113	165	445	725	1,007	1,291	1,576	1,863	2,150	1,526	899	269	-365	-1,002	-1,005	-1,008	-1,012	-1,015	-1,018
Legislative Reductions Commercial Emissions (MT CO2e)	0	-79	-169	-228	-292	-363	-439	-522	-594	-671	-752	-837	-927	-1,035	-1,144	-1,253	-1,363	-1,474	-1,585	-1,697	-1,810	-1,923	-2,036	-1,914	-1,791	-1,668	-1,543	-1,418	-1,423	-1,427	-1,432	-1,437	-1,441
Combined Legislative Reduction of On-Road Emissions (MT CO2e)	0	-112	-238	-1,297	-2,449	-3,695	-5,034	-6,466	-7,614	-8,828	-10,108	-11,453	-12,865	-13,450	-14,042	-14,641	-15,245	-15,856	-16,473	-17,097	-17,727	-18,363	-19,005	-19,113	-19,223	-19,333	-19,443	-19,555	-19,610	-19,665	-19,720	-19,775	-19,829
	0%	0%	1%	4%	6%	9%	12%	15%	17%	19%	21%	23%	25%	26%	27%	28%	29%	30%	31%	32%	33%	34%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%

Leg Adj Public Transit

Leg Adj Bus Emission Factor (Innovative Clean Transit)	0.001821643	0.001738841	0.001656039	0.001573237	0.001490435	0.001407633	0.001324831	0.001242029	0.00115923	0.00107643	0.00099362	0.00091082	0.00082802	0.00074522	0.00066242	0.00057961	0.00049681	0.00041401	0.00033121	0.00024841	0.0001656	8.2802E-05	0	0	0	0	0	0	0	0	0	0	0	0
BAU VMT	407,912	419,535	431,159	442,782	454,406	466,029	477,652	489,276	500,899	512,522	524,146	535,769	547,393	559,016	570,639	582,263	593,886	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509	605,509
Leg Adj Public Transit Emissions	743	730	714	697	677	656	633	608	581	552	521	488	453	417	378	337	295	251	201	150	100	50	0	0	0	0	0	0	0	0	0	0	0	0
Legislative Reduction	0	-35	-71	-110	-151	-193	-237	-284	-332	-382	-434	-488	-544	-602	-662	-723	-787	-852	-902	-953	-1,003	-1,053	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103

EMFAC DATA FORECAST YEAR **2020**

Paste data -->

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Region: Riverside (SC)
Calendar Year: 2020
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Helper Column	Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	NOx_RUNEX	NOx_IDLEX	NOx_STREX	PM2.5_RUNEX	PM2.5_IDLEX	PM2.5_STREX	PM2.5_PMTW	PM2.5_PMBW	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW
HHDTGAS	Riverside (SC)	2020	HHDT	Aggregated	Aggregated	GAS	7.834009455	495.6972074	156.7428612	5.401136467	0	0.607457471	0.000944923	0	0.000796605	0.005000001	0.026460008	0.00102769	0	0.00086638	0.02000001	0.06174002
HHDTDSL	Riverside (SC)	2020	HHDT	Aggregated	Aggregated	DSL	14896.97361	1849783.594	155837.5901	3.847966556	62.62895728	1.897200988	0.064071674	0.116936842	0	0.008812582	0.025908992	0.06696871	0.122224207	0	0.03525033	0.06045432
HHDTNG	Riverside (SC)	2020	HHDT	Aggregated	Aggregated	NG	195.4860734	7927.187827	762.3956863	2.765504806	23.47431555	0	0.005926184	0.049027878	0	0.009000003	0.026460008	0.006194139	0.051244701	0	0.03600001	0.06174002
LDAGAS	Riverside (SC)	2020	LDA	Aggregated	Aggregated	GAS	544330.7452	22811940.05	2577014.349	0.045201034	0	0.204976844	0.001339613	0	0.001867181	0.002000001	0.015750005	0.001456908	0	0.002030591	0.008	0.03675001
LDADSL	Riverside (SC)	2020	LDA	Aggregated	Aggregated	DSL	4801.796275	211707.5045	23004.1958	0.099093464	0	0	0.00830876	0	0	0.002000001	0.015750005	0.008684445	0	0	0.008	0.03675001
LDAELEC	Riverside (SC)	2020	LDA	Aggregated	Aggregated	ELEC	5917.336596	225470.3815	29889.44984	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001
LDT1GAS	Riverside (SC)	2020	LDT1	Aggregated	Aggregated	GAS	56941.70538	2171443.935	257765.5069	0.163137135	0	0.341346025	0.002240094	0	0.002971296	0.002000001	0.015750005	0.002436106	0	0.003231236	0.008	0.03675001
LDT1DSL	Riverside (SC)	2020	LDT1	Aggregated	Aggregated	DSL	32.63987716	703.6072479	107.6552039	1.304523511	0	0	0.167472362	0	0	0.002000001	0.015750005	0.175044719	0	0	0.008	0.03675001
LDT1ELEC	Riverside (SC)	2020	LDT1	Aggregated	Aggregated	ELEC	131.0488487	5032.136237	662.2684204	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001
LDT2GAS	Riverside (SC)	2020	LDT2	Aggregated	Aggregated	GAS	172787.9159	6953901.02	808078.8723	0.09839573	0	0.343068492	0.001409228	0	0.001892243	0.002000001	0.015750005	0.001532582	0	0.002057853	0.008	0.03675001
LDT2DSL	Riverside (SC)	2020	LDT2	Aggregated	Aggregated	DSL	801.9527862	38380.62057	3973.327641	0.061786722	0	0	0.007330449	0	0	0.002000001	0.015750005	0.007661899	0	0	0.008	0.03675001
LDT2ELEC	Riverside (SC)	2020	LDT2	Aggregated	Aggregated	ELEC	857.4023436	27869.83896	4368.931582	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001
LHDT1GAS	Riverside (SC)	2020	LHDT1	Aggregated	Aggregated	GAS	15903.23291	522854.1613	236934.4745	0.259370315	0.040662364	0.577590239	0.001013511	0	0.000418982	0.002000001	0.032760009	0.001101617	0	0.000454948	0.008	0.07644002
LHDT1DSL	Riverside (SC)	2020	LHDT1	Aggregated	Aggregated	DSL	15724.26694	546497.7935	197791.4969	3.335804582	2.409114904	0	0.021548318	0.026154927	0	0.003000001	0.032760009	0.022522638	0.027337536	0	0.012	0.07644002
LHDT2GAS	Riverside (SC)	2020	LHDT2	Aggregated	Aggregated	GAS	2247.021483	74925.36029	33477.27203	0.222576105	0.040626208	0.572547055	0.000855143	0	0.000330565	0.002000001	0.038220011	0.000929939	0	0.000359408	0.008	0.08918003
LHDT2DSL	Riverside (SC)	2020	LHDT2	Aggregated	Aggregated	DSL	5986.499893	210205.549	75302.63764	2.638318666	2.410926957	0	0.019204131	0.026007111	0	0.003000001	0.038220011	0.020072457	0.027183037	0	0.012	0.08918003
MCYGAS	Riverside (SC)	2020	MCY	Aggregated	Aggregated	GAS	27562.03276	186161.6877	55124.06552	1.133813745	0	0.262463883	0.00156173	0	0.002742616	0.001	0.005040001	0.001667444	0	0.002907865	0.004	0.01176
MDVGAS	Riverside (SC)	2020	MDV	Aggregated	Aggregated	GAS	154154.4763	5759434.716	707160.9966	0.135656352	0	0.438100033	0.001414631	0	0.002004409	0.002000001	0.015750005	0.00153732	0	0.002177981	0.008	0.03675001
MDVDSL	Riverside (SC)	2020	MDV	Aggregated	Aggregated	DSL	2774.383834	122611.3071	13585.962	0.07467919	0	0	0.005657552	0	0	0.002000001	0.015750005	0.005913361	0	0	0.008	0.03675001
MDVELEC	Riverside (SC)	2020	MDV	Aggregated	Aggregated	ELEC	297.2379218	9882.784579	1525.076046	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001
MHGAS	Riverside (SC)	2020	MH	Aggregated	Aggregated	GAS	5298.489729	42692.11287	530.0609125	0.486618124	0	0.322131136	0.001145711	0	0.000346324	0.003000001	0.055860016	0.001245459	0	0.000376157	0.012	0.13034004
MHDSL	Riverside (SC)	2020	MH	Aggregated	Aggregated	DSL	1995.592802	16646.26539	199.5592802	4.662561416	0	0	0.142771223	0	0	0.004000001	0.055860016	0.149226705	0	0	0.01600001	0.13034004
MHDTGAS	Riverside (SC)	2020	MHDT	Aggregated	Aggregated	GAS	1269.719696	51275.62336	25404.55167	0.590666358	0.089022597	0.386426527	0.000858672	0	0.000451389	0.003000001	0.055860016	0.000933885	0	0.000490926	0.012	0.13034004
MHDTDSL	Riverside (SC)	2020	MHDT	Aggregated	Aggregated	DSL	11983.99633	722759.9463	118821.8643	3.203130997	9.135461176	1.194648029	0.104954052	0.03426208	0	0.003000001	0.055860016	0.109699609	0.035811259	0	0.012	0.13034004
OBUSGAS	Riverside (SC)	2020	OBUS	Aggregated	Aggregated	GAS	443.2109762	16098.84235	8867.765211	0.611907206	0.064871022	0.332450693	0.000650772	0	0.00025553	0.003000001	0.055860016	0.000707434	0	0.000277116	0.012	0.13034004
OBUSDSL	Riverside (SC)	2020	OBUS	Aggregated	Aggregated	DSL	223.9038271	15117.15957	2143.053993	4.425559333	23.24074598	1.245849654	0.114937547	0.11098792	0	0.003000001	0.055860016	0.120134513	0.116006301	0	0.012	0.13034004
SBUSGAS	Riverside (SC)	2020	SBUS	Aggregated	Aggregated	GAS	395.8309322	14360.45933	1583.323729	0.347214625	0.9265304	0.550194512	0.000627284	0	0.000267564	0.002000001	0.319200087	0.000682229	0	0.000291001	0.008	0.7448002
SBUSDSL	Riverside (SC)	2020	SBUS	Aggregated	Aggregated	DSL	812.4348173	25716.68219	9375.385152	7.585470318	48.55939488	0.595369184	0.045849014	0.055706484	0	0.003000001	0.319200091	0.047922103	0.058225284	0	0.012	0.7448021
UBUSGAS	Riverside (SC)	2020	UBUS	Aggregated	Aggregated	GAS	162.5145119	22881.1992	650.0580478	0.124199278	0	0.514913539	0.001046461	0	0.000431367	0.002386561	0.045038932	0.001138122	0	0.000469151	0.00954624	0.10509084
UBUSDSL	Riverside (SC)	2020	UBUS	Aggregated	Aggregated	DSL	1.105797941	58.57190354	4.423191762	0.477460704	0	0	0.004085612	0	0	0.003000002	0.055860034	0.004270345	0	0	0.01200001	0.13034008
UBUSELEC	Riverside (SC)	2020	UBUS	Aggregated	Aggregated	ELEC	0.058469431	1.251702935	0.233877724	0	0	0	0	0	0	0.003000002	0.055860034	0	0	0	0.01200001	0.13034008
UBUSNG	Riverside (SC)	2020	UBUS	Aggregated	Aggregated	NG	201.6964296	26538.11439	806.7857186	0.442847878	0	0	0.002904072	0	0	0.007364732	0.034472854	0.003035381	0	0	0.02945893	0.08043666

Helper Column	Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
	Passenger Vehicles											
LDADSL	Riverside (SC)	2020	LDA	DSL	4801.796275	211707.5045	0.55%	211707.5045	204.4716582	0.000726465	0.0000000	204.4919992
LDT1DSL	Riverside (SC)	2020	LDT1	DSL	32.63987716	703.6072479	0.00%	703.6072479	404.309644	0.010358787	0.0000000	404.59969
LDT2DSL	Riverside (SC)	2020	LDT2	DSL	801.9527862	38380.62057	0.10%	38380.62057	274.9744929	0.000777006	0.0000000	274.9962491
MDVDSL	Riverside (SC)	2020	MDV	DSL	2774.383834	122611.3071	0.32%	122611.3071	372.9108444	0.00056362	0.0000000	372.9266258
LDAELEC	Riverside (SC)	2020	LDA	ELEC	5917.336596	225470.3815	0.59%	225470.3815	0	0	0.0000000	0
LDT1ELEC	Riverside (SC)	2020	LDT1	ELEC	131.0488487	5032.136237	0.01%	5032.136237	0	0	0.0000000	0
LDT2ELEC	Riverside (SC)	2020	LDT2	ELEC	857.4023436	27869.83896	0.07%	27869.83896	0	0	0.0000000	0
MDVELEC	Riverside (SC)	2020	MDV	ELEC	297.2379218	9882.784579	0.03%	9882.784579	0	0	0.0000000	0
MCYGAS	Riverside (SC)	2020	MCY	GAS	27562.03276	186161.6877	0.48%	186161.6877	207.3125153	0.318787748	0.2454222	281.2754603
LDAGAS	Riverside (SC)	2020	LDA	GAS	544330.7452	22811940.05	59.21%	22811940.05	274.1597695	0.002840208	0.0574992	289.476573
LDT1GAS	Riverside (SC)	2020	LDT1	GAS	56941.70538	2171443.935	5.64%	2171443.935	321.8230417	0.008944652	0.0985134	348.1795392
LDT2GAS	Riverside (SC)	2020	LDT2	GAS	172787.9159	6953901.02	18.05%	6953901.02	347.8501844	0.004558055	0.0796464	369.0841118
MDVGAS	Riverside (SC)	2020	MDV	GAS	154154.4763	5759434.716	14.95%	5759434.716	432.0191681	0.006400531	0.1006846	458.8798062
			Passenger Vehicle Total			***38524539.59***			**311.4503659**	**0.00551283**	**0.07021529**	**330.211777**
			Passenger Gasoline Total			**37882881.41**	**98.33%**		**313.0711927**	**0.004032776**	**0.070198555**	**331.7867274**
			Passenger Diesel Total			**373403.0394**	**0.97%**		**267.4039226**	**0.000696338**	**0**	**267.42342**
			Passenger Electric Total			**268255.1413**	**0.70%**		**0**	**0**	**0**	**0**
	Light Trucks											
LHDT1DSL	Riverside (SC)	2020	LHDT1	DSL	15724.26694	546497.7935	40.35%	546497.7935	492.0502563	0.004578723	0.0000000	492.1784605
LHDT2DSL	Riverside (SC)	2020	LHDT2	DSL	5986.499893	210205.549	15.52%	210205.549	535.9060307	0.003826912	0.0000000	536.0131842
LHDT1GAS	Riverside (SC)	2020	LHDT1	GAS	15903.23291	522854.1613	38.60%	522854.1613	795.6050085	0.007192705	0.0303336	803.8448159
LHDT2GAS	Riverside (SC)	2020	LHDT2	GAS	2247.021483	74925.36029	5.53%	74925.36029	909.5122114	0.004856392	0.0281201	917.1000084
			Light-Heavy Truck Total			***1354482.864***			**639.1263731**	**0.00548645**	**0.013264819**	**642.7951708**
			Light-Heavy Truck Gasoline Total			**597779.5216**	**44.13%**		**809.8820754**	**0.006899873**	**0.030056182**	**818.0401602**
			Light-Heavy Truck Diesel Total			**756703.3425**	**55.87%**		**504.2330056**	**0.004369877**	**0**	**504.3553622**
	Medium Trucks											
MHDTGAS	Riverside (SC)	2020	MHDT	GAS	1269.719696	51275.62336	**6.62%**	51275.62336	1649.872709	0.01500247	0.0414986	1661.289894
MHDTDSL	Riverside (SC)	2020	MHDT	DSL	11983.99633	722759.9463	**93.38%**	722759.9463	950.3271498	0.006548667	0.0000000	950.5105125
			Medium-Heavy Truck Total			***774035.5697***			**996.6682173**	**0.007108685**	**0.002749052**	**997.5957593**
	Heavy Trucks											
HHDTGAS	Riverside (SC)	2020	HHDT	GAS	7.834009455	495.6972074	**0.03%**	495.6972074	2137.052433	0.123645218	0.0002130	2140.570942
HHDTDSL	Riverside (SC)	2020	HHDT	DSL	14896.97361	1849783.594	**99.55%**	1849783.594	1395.766753	0.004878989	0.0000000	1395.903365
HHDTNG	Riverside (SC)	2020	HHDT	NG	195.4860734	7927.187827	**0.43%**	7927.187827	3328.879	4.926461335	0.0000000	3466.819917
			Heavy-Heavy Truck Total			***1858206.479***			**1404.211238**	**0.025906351**	**5.68182E-08**	**1404.936631**
	Urban Buses											
UBUSGAS	Riverside (SC)	2020	UBUS	GAS	162.5145119	22881.1992	**46.25%**	22881.1992	1392.787724	0.003871665	0.0524545	1406.796571
UBUSDSL	Riverside (SC)	2020	UBUS	DSL	1.105797941	58.57190354	**0.12%**	58.57190354	1141.140363	0.037451096	0.0000000	1142.188994
UBUSNG	Riverside (SC)	2020	UBUS	NG	201.6964296	26538.11439	**53.64%**	26538.11439	1857.249841	5.666721558	0.0000000	2015.918045
			Urban Bus Total			***49477.88549***			**1641.610187**	**3.041255408**	**0.02425774**	**1733.193639**

CO2_RUNEX	CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	SOx_RUNEX	SOx_IDLEX	SOx_STREX
2137.052433	0	50.03068205	0.123645218	0	0.000212993	0.174661051	0	0.013395631	0.640494788	0	0.001092076	0.168989118	0.89349555	0.058761672	0.096425904	0.934608492	0	0.001195686	0.168989118	0.89349555	0.058761672	0.096425904	32.10732755	0	5.926908749	0.021147866	0	0.000495094
1395.766753	11437.15955	0	0.004878989	0.218733758	0	0.219395096	1.797762209	0	0.10504329	4.709277818	0	0	0	0	0	0.11958379	5.36115432	0	0	0	0	0	0.425117846	57.31651367	0	0.013186512	0.108052612	0
3328.879	3939.157685	0	4.926461335	1.310770359	0	0.678613761	0.803023063	0	0.300668518	0.065550623	0	0	0	0	0	5.29019069	1.391085716	0	0	0	0	0	13.59941426	21.38855545	0	0	0	0
274.1597695	0	57.5059428	0.002840208	0	0.057499161	0.004980263	0	0.027721517	0.011012453	0	0.256909425	0.106628573	0.220515683	0.236086268	0.304712568	0.016055338	0	0.28128127	0.106628573	0.220515683	0.236086268	0.304712568	0.721375171	0	2.251954384	0.002713033	0	0.000569068
204.4716582	0	0	0.000726465	0	0	0.032140097	0	0	0.015640354	0	0	0	0	0	0	0.017805503	0	0	0	0	0	0	0.202761203	0	0	0.001932992	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
321.8230417	0	68.96382258	0.008944652	0	0.098513386	0.011557847	0	0.033667099	0.039700778	0	0.511156157	0.291864641	0.952501169	0.655644537	0.969167772	0.057880147	0	0.559647709	0.291864641	0.952501169	0.655644537	0.969167772	1.772565743	0	2.559916331	0.0031847	0	0.000682453
404.309644	0	0	0.010358787	0	0	0.063551846	0	0	0.223018579	0	0	0	0	0	0	0	0	0	0	0	0	0	1.36127214	0	0	0.00382218	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
347.8501844	0	75.02433769	0.004558055	0	0.079646422	0.007874742	0	0.036711289	0.01861055	0	0.373288485	0.143546414	0.445616529	0.371288439	0.45145738	0.0271337	0	0.408702113	0.143546414	0.445616529	0.371288439	0.45145738	1.037296826	0	2.905228034	0.00344226	0	0.000742427
274.9744929	0	0	0.000777006	0	0	0.043222161	0	0	0.016728472	0	0	0	0	0	0	0.019044253	0	0	0	0	0	0	0.118866793	0	0	0.002599498	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
795.6050085	123.2589812	19.2772164	0.007192705	0.128003554	0.030333629	0.015555837	0.00319538	0.044159586	0.034783777	0.465855326	0.152076856	0.146066526	0.921294453	0.0385302	0.075880348	0.050104348	0.679503728	0.166476994	0.146066526	0.921294453	0.0385302	0.075880348	0.945529908	3.746762343	1.80323615	0.007873157	0.001219748	0.000190764
492.0502563	139.0264342	0	0.004578723	0.005098128	0	0.077343448	0.021853019	0	0.098577218	0.109759705	0	0	0	0	0	0.112223609	0.124954127	0	0	0	0	0	0.670593784	0.909745076	0	0.004651644	0.0013143	0
909.5122114	141.9037357	21.77850572	0.004856392	0.130019907	0.028120068	0.014528834	0.003218205	0.04394523	0.021556173	0.465746366	0.138358536	0.123464533	0.755613828	0.032189894	0.062009129	0.031350126	0.679574624	0.151480908	0.123464533	0.755613828	0.032189894	0.062009129	0.583850809	3.758093194	1.711467616	0.009000361	0.001404252	0.000215516
535.9060307	223.5046664	0	0.003826912	0.005098128	0	0.084236965	0.035131821	0	0.082391163	0.109759705	0	0	0	0	0	0.093796861	0.124954127	0	0	0	0	0	0.553605655	0.909745076	0	0.005066239	0.002112923	0
207.3125153	0	61.2727931	0.318787748	0	0.245422219	0.065472394	0	0.014962082	2.172750939	0	1.859797359	0.787002703	1.919709665	1.505114663	2.818861701	2.660458295	0	2.023421113	0.787002703	1.919709665	1.505114663	2.818861701	19.76232271	0	8.583718157	0.002051525	0	0.000606344
432.0191681	0	93.6435144	0.006400531	0	0.100684616	0.010219122	0	0.041019833	0.028713163	0	0.50315745	0.171690782	0.499112001	0.455040666	0.525957639	0.040381956	0	0.55083408	0.171690782	0.499112001	0.455040666	0.525957639	1.306134873	0	3.541526945	0.00427518	0	0.000926678
372.9108444	0	0	0.00056362	0	0	0.058616392	0	0	0.012134413	0	0	0	0	0	0	0.013814222	0	0	0	0	0	0	0.18890582	0	0	0.003525349	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
1691.263956	0	26.71611257	0.014617978	0	0.034305275	0.028581274	0	0.033669769	0.064778578	0	0.143337219	0.097534676	2.158894901	0.059685451	0.167523925	0.093733811	0	0.156911184	0.097534676	2.158894901	0.059685451	0.167523925	2.086869749	0	3.064342848	0.016736428	0	0.000264378
948.9129331	0	0	0.003432359	0	0	0.149155899	0	0	0.073896663	0	0	0	0	0	0	0.084126438	0	0	0	0	0	0	0.355394015	0	0	0.00897064	0	0
1649.872709	552.588477	40.23272652	0.01500247	0.252107164	0.04149855	0.027750683	0.007041431	0.028190471	0.074130704	0.99926745	0.229498708	0.095845869	0.493182282	0.030444615	0.059115815	0.108171349	1.458128717	0.251272197	0.095845869	0.493182282	0.030444615	0.059115815	2.048370944	14.31856358	5.051026719	0.016326828	0.005468311	0.000398135
950.3271498	843.1528284	0	0.006548667	0.006290705	0	0.149378194	0.132531883	0	0.140990995	0.13543715	0	0	0	0	0	0.160507515	0.154184886	0	0	0	0	0	0.530064037	2.332141131	0	0.00897822	0.00796569	0
1678.972286	385.8468321	27.53476018	0.014660503	0.192274377	0.032466766	0.028798506	0.005181201	0.024849431	0.071384604	0.743732475	0.175437611	0.032847234	0.350558408	0.028605375	0.066314821	0.103664667	1.084795824	0.192037432	0.032847234	0.350558408	0.028605375	0.066314821	1.955345243	5.757508575	3.570024627	0.016614792	0.003818267	0.000272479
1161.989968	2657.858577	0	0.009036385	0.059157975	0	0.182648641	0.417778355	0	0.194550885	1.273654982	0	0	0	0	0	0.221481373	1.449959245	0	0	0	0	0	0.684226375	12.33766034	0	0.010977905	0.02511013	0
899.0442897	2677.457392	48.41478789	0.009392166	2.38232159	0.054943379	0.021581264	0.085829986	0.050655628	0.04648751	10.64151815	0.319546758	0.063118606	0.387580901	0.017576136	0.035415451	0.067834465	15.5280783	0.349863478	0.063118606	0.387580901	0.017576136	0.035415451	1.044255823	82.24087757	7.650093844	0.008896772	0.026495611	0.000479104
1254.640506	3777.928241	0	0.006297302	0.013376076	0	0.197212016	0.593837709	0	0.135579186	0.287983254	0	0	0	0	0	0.154346582	0.327847013	0	0	0	0	0	0.364594344	5.079022242	0	0.011853221	0.035691993	0
1392.787724	0	52.66141273	0.003871665	0	0.052454492	0.013261263	0	0.05749177	0.011503557	0	0.203894706	0.022851834	0.102214235	0.006945728	0.012037883	0.016785963	0	0.223239038	0.022851834	0.102214235	0.006945728	0.012037883	0.182155383	0	4.380377904	0.013782764	0	0.000521127
1141.140363	0	0	0.037451096	0	0	0.179371374	0	0	0.000535102	0	0	0	0	0	0	0.03822159	0	0	0	0	0	0	0.057156358	0	0	0.01078788	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1857.249841	0	0	5.666721558	0	0	0.37861253	0	0	0.08096627	0	0	0	0	0	0	5.783304989	0	0	0	0	0	0	43.79817908	0	0	0	0	0

EMFAC DATA FORECAST YEAR **2025**

Paste data -->

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Region: Riverside (SC)
Calendar Year: 2025
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Helper Column	Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	NOx_RUNEX	NOx_IDLEX	NOx_STREX	PM2.5_RUNEX	PM2.5_IDLEX	PM2.5_STREX	PM2.5_PMTW	PM2.5_PMBW	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW	CO2_RUNEX
HHDTGAS	Riverside (SC)	2025	HHDT	Aggregated	Aggregated	GAS	5.917085626	489.3585501	118.3890492	3.386183663	0	0.113293785	0.000891675	0	0.000533223	0.005000001	0.026460008	0.000969778	0	0.000579929	0.02000001	0.06174002	1859.068895
HHDTDSL	Riverside (SC)	2025	HHDT	Aggregated	Aggregated	DSL	16787.91989	2073941.582	177897.7482	1.947821562	55.65074882	2.511240927	0.023399284	0.022579722	0	0.008801891	0.02587756	0.024457296	0.023600677	0	0.03520757	0.06038097	1220.386579
HHDTNG	Riverside (SC)	2025	HHDT	Aggregated	Aggregated	NG	366.9607711	14928.54824	1431.147007	1.207892251	19.73040555	0	0.003892218	0.020577646	0	0.009000003	0.026460008	0.004068207	0.021508076	0	0.03600001	0.06174002	3059.937465
LDAGAS	Riverside (SC)	2025	LDA	Aggregated	Aggregated	GAS	634445.4088	24819468.5	2999831.308	0.025937555	0	0.152866177	0.001096772	0	0.001550978	0.002000001	0.015750005	0.001192839	0	0.00168683	0.008	0.03675001	240.1096538
LDADSL	Riverside (SC)	2025	LDA	Aggregated	Aggregated	DSL	6750.331621	273894.7973	32236.019	0.039460201	0	0	0.004010709	0	0	0.002000001	0.015750005	0.004192056	0	0	0.008	0.03675001	180.8476117
LDAELEC	Riverside (SC)	2025	LDA	Aggregated	Aggregated	ELEC	17340.99834	715536.0137	86549.86824	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT1GAS	Riverside (SC)	2025	LDT1	Aggregated	Aggregated	GAS	64862.57189	2387662.891	297460.563	0.080036352	0	0.224259489	0.001489405	0	0.002066289	0.002000001	0.015750005	0.001619863	0	0.002247278	0.008	0.03675001	281.476261
LDT1DSL	Riverside (SC)	2025	LDT1	Aggregated	Aggregated	DSL	22.09264048	500.8045087	74.57591289	0.861881958	0	0	0.11012703	0	0	0.002000001	0.015750005	0.115106486	0	0	0.008	0.03675001	372.8764631
LDT1ELEC	Riverside (SC)	2025	LDT1	Aggregated	Aggregated	ELEC	840.0670631	35870.85658	4237.919514	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT2GAS	Riverside (SC)	2025	LDT2	Aggregated	Aggregated	GAS	196401.0012	7476968.972	920583.0346	0.051520429	0	0.219961104	0.001136712	0	0.00157853	0.002000001	0.015750005	0.001236279	0	0.001716795	0.008	0.03675001	291.960893
LDT2DSL	Riverside (SC)	2025	LDT2	Aggregated	Aggregated	DSL	1411.82251	60038.76398	6916.520273	0.034017297	0	0	0.004035167	0	0	0.002000001	0.015750005	0.004217619	0	0	0.008	0.03675001	238.1716277
LDT2ELEC	Riverside (SC)	2025	LDT2	Aggregated	Aggregated	ELEC	3434.450512	100004.4721	17256.03431	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LHDT1GAS	Riverside (SC)	2025	LHDT1	Aggregated	Aggregated	GAS	14855.10977	474380.1042	221319.0015	0.152531263	0.036018299	0.496957507	0.000931255	0	0.000348083	0.002000001	0.032760009	0.001012825	0	0.000378571	0.008	0.07644002	752.1983655
LHDT1DSL	Riverside (SC)	2025	LHDT1	Aggregated	Aggregated	DSL	15929.66362	511419.863	200375.1288	2.019895045	2.022562002	0	0.015930088	0.02598244	0	0.003000001	0.032760009	0.016650376	0.02715725	0	0.012	0.07644002	461.8679033
LHDT2GAS	Riverside (SC)	2025	LHDT2	Aggregated	Aggregated	GAS	2257.609118	71801.06903	33635.01202	0.131369083	0.035835042	0.492955781	0.000827727	0	0.000290038	0.002000001	0.038220011	0.000900229	0	0.000315443	0.008	0.08918003	860.4473653
LHDT2DSL	Riverside (SC)	2025	LHDT2	Aggregated	Aggregated	DSL	6279.413605	200055.2549	78987.12365	1.626437918	2.022626013	0	0.01618995	0.026158371	0	0.003000001	0.038220011	0.016921988	0.027341137	0	0.012	0.08918003	503.8737569
MCYGAS	Riverside (SC)	2025	MCY	Aggregated	Aggregated	GAS	29089.61205	176339.2601	58179.22411	1.119383515	0	0.26305578	0.001748522	0	0.002532061	0.001	0.005040001	0.001872313	0	0.002698308	0.004	0.01176	207.4293794
MDVGAS	Riverside (SC)	2025	MDV	Aggregated	Aggregated	GAS	154545.0839	5434458.472	708075.5859	0.068286585	0	0.284423528	0.001145026	0	0.001626311	0.002000001	0.015750005	0.001245313	0	0.001768748	0.008	0.03675001	369.5944041
MDVDSL	Riverside (SC)	2025	MDV	Aggregated	Aggregated	DSL	3932.245175	155115.8465	18927.02863	0.036746435	0	0	0.003502835	0	0	0.002000001	0.015750005	0.003661218	0	0	0.008	0.03675001	325.3993277
MDVELEC	Riverside (SC)	2025	MDV	Aggregated	Aggregated	ELEC	2250.064657	66744.92315	11374.61152	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
MHGAS	Riverside (SC)	2025	MH	Aggregated	Aggregated	GAS	4266.702301	32841.07891	426.8408982	0.312793224	0	0.346393086	0.000950413	0	0.00027931	0.003000001	0.055860016	0.001033661	0	0.000303775	0.012	0.13034004	1602.717016
MHDSL	Riverside (SC)	2025	MH	Aggregated	Aggregated	DSL	1959.172346	14490.48271	195.9172346	4.017638479	0	0	0.120080244	0	0	0.004000001	0.055860016	0.12550974	0	0	0.01600001	0.13034004	912.9869246
MHDTGAS	Riverside (SC)	2025	MHDT	Aggregated	Aggregated	GAS	1438.72636	58388.27343	28786.037	0.232717361	0.089745115	0.342077215	0.000847767	0	0.000384135	0.003000001	0.055860016	0.000922024	0	0.000417782	0.012	0.13034004	1517.43699
MHDTDSL	Riverside (SC)	2025	MHDT	Aggregated	Aggregated	DSL	12401.54695	763294.7123	124114.8543	0.951709773	4.457611471	2.147585163	0.009762661	0.003724224	0	0.003000001	0.055860016	0.010204085	0.003892617	0	0.012	0.13034004	834.6715024
OBUSGAS	Riverside (SC)	2025	OBUS	Aggregated	Aggregated	GAS	435.7273524	14480.56576	8718.032866	0.367231937	0.064991088	0.313195548	0.000773063	0	0.000256996	0.003000001	0.055860016	0.000840776	0	0.000279506	0.012	0.13034004	1555.060029
OBUSDSL	Riverside (SC)	2025	OBUS	Aggregated	Aggregated	DSL	238.3575855	16706.49314	2277.720008	1.322419923	11.12427013	2.205657442	0.014955852	0.003587362	0	0.003000001	0.055860016	0.01563209	0.003749566	0	0.012	0.13034004	1039.963755
SBUSGAS	Riverside (SC)	2025	SBUS	Aggregated	Aggregated	GAS	450.3676781	15279.04245	1801.470712	0.354992113	0.9265304	0.608145921	0.000746935	0	0.000324524	0.002000001	0.319200087	0.00081236	0	0.00035295	0.008	0.7448002	876.0940342
SBUSDSL	Riverside (SC)	2025	SBUS	Aggregated	Aggregated	DSL	916.0655598	29066.07334	10571.26955	6.027764064	41.50901721	0.949897146	0.033226219	0.036121867	0	0.003000001	0.319200091	0.034728562	0.037755138	0	0.012	0.74480021	1176.739192
UBUSGAS	Riverside (SC)	2025	UBUS	Aggregated	Aggregated	GAS	167.3661527	23564.28502	669.4646108	0.148619548	0	0.491986202	0.001222458	0	0.000524879	0.002386561	0.045038932	0.001329535	0	0.000570853	0.00954624	0.10509084	1336.205443
UBUSDSL	Riverside (SC)	2025	UBUS	Aggregated	Aggregated	DSL	0.141961099	11.67769301	0.567844395	0.477528271	0	0	0.004084051	0	0	0.003000002	0.055860034	0.004268714	0	0	0.01200001	0.13034008	1093.673357
UBUSELEC	Riverside (SC)	2025	UBUS	Aggregated	Aggregated	ELEC	0.058469431	1.251702935	0.233877724	0	0	0	0	0	0	0.003000002	0.055860034	0	0	0	0.01200001	0.13034008	0
UBUSNG	Riverside (SC)	2025	UBUS	Aggregated	Aggregated	NG	208.7163855	27379.0524	834.865542	0.442623237	0	0	0.002902615	0	0	0.007356972	0.034510881	0.003033859	0	0	0.02942789	0.08052539	1856.440922

Helper Column	Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
	Passenger Vehicles											
LDADSL	Riverside (SC)	2025	LDA	DSL	6750.331621	273894.7973	0.66%	273894.7973	180.8476117	0.000409874	0.0000000	180.8590882
LDT1DSL	Riverside (SC)	2025	LDT1	DSL	22.09264048	500.8045087	0.00%	500.8045087	372.8764631	0.006936263	0.0000000	373.0706785
LDT2DSL	Riverside (SC)	2025	LDT2	DSL	1411.82251	60038.76398	0.14%	60038.76398	238.1716277	0.000566644	0.0000000	238.1874937
MDVDSL	Riverside (SC)	2025	MDV	DSL	3932.245175	155115.8465	0.37%	155115.8465	325.3993277	0.000390163	0.0000000	325.4102523
LDAELEC	Riverside (SC)	2025	LDA	ELEC	17340.99834	715536.0137	1.72%	715536.0137	0	0	0.0000000	0
LDT1ELEC	Riverside (SC)	2025	LDT1	ELEC	840.0670631	35870.85658	0.09%	35870.85658	0	0	0.0000000	0
LDT2ELEC	Riverside (SC)	2025	LDT2	ELEC	3434.450512	100004.4721	0.24%	100004.4721	0	0	0.0000000	0
MDVELEC	Riverside (SC)	2025	MDV	ELEC	2250.064657	66744.92315	0.16%	66744.92315	0	0	0.0000000	0
MCYGAS	Riverside (SC)	2025	MCY	GAS	29089.61205	176339.2601	0.42%	176339.2601	207.4293794	0.311277616	0.2399358	279.72815
LDAGAS	Riverside (SC)	2025	LDA	GAS	634445.4088	24819468.5	59.52%	24819468.5	240.1096538	0.00156859	0.0401032	250.7809117
LDT1GAS	Riverside (SC)	2025	LDT1	GAS	64862.57189	2387662.891	5.73%	2387662.891	281.476261	0.004404957	0.0611346	297.8002709
LDT2GAS	Riverside (SC)	2025	LDT2	GAS	196401.0012	7476968.972	17.93%	7476968.972	291.960893	0.002635444	0.0554628	306.7323155
MDVGAS	Riverside (SC)	2025	MDV	GAS	154545.0839	5434458.472	13.03%	5434458.472	369.5944041	0.003411775	0.0687987	387.9215996
			Passenger Vehicle Total			***41702604.57***			**263.150576**	**0.003424154**	**0.047291896**	**275.7788048**
			Passenger Gasoline Total			**40294898.1**	**96.62%**		**268.5946088**	**0.00217634**	**0.047894032**	**281.3474648**
			Passenger Diesel Total			**489550.2123**	**1.17%**		**233.8760715**	**0.000429531**	**0**	**233.8880984**
			Passenger Electric Total			**918156.2655**	**2.20%**		**0**	**0**	**0**	**0**
	Light Trucks	***Light Trucks***										
LHDT1DSL	Riverside (SC)	2025	LHDT1	DSL	15929.66362	511419.863	40.66%	511419.863	461.8679033	0.003334475	0.0000000	461.9612686
LHDT2DSL	Riverside (SC)	2025	LHDT2	DSL	6279.413605	200055.2549	15.91%	200055.2549	503.8737569	0.002903659	0.0000000	503.9550594
LHDT1GAS	Riverside (SC)	2025	LHDT1	GAS	14855.10977	474380.1042	37.72%	474380.1042	752.1983655	0.00402855	0.0224096	758.2497208
LHDT2GAS	Riverside (SC)	2025	LHDT2	GAS	2257.609118	71801.06903	5.71%	71801.06903	860.4473653	0.002565587	0.0211724	866.1298981
			Light-Heavy Truck Total			***1257656.291***			**600.8159763**	**0.003483849**	**0.009661538**	**603.4738315**
			Light-Heavy Truck Gasoline Total			**546181.1732**	**43.43%**		**766.4287972**	**0.003836229**	**0.022247002**	**772.4316671**
			Light-Heavy Truck Diesel Total			**711475.1179**	**56.57%**		**473.6792675**	**0.003213337**	**0**	**473.7692409**
	Medium Trucks	***Medium Trucks***										
MHDTGAS	Riverside (SC)	2025	MHDT	GAS	1438.72636	58388.27343	7.11%	58388.27343	1517.43699	0.005605461	0.0343975	1526.709291
MHDTDSL	Riverside (SC)	2025	MHDT	DSL	12401.54695	763294.7123	92.89%	763294.7123	834.6715024	0.000341025	0.0000000	834.6810511
			Medium-Heavy Truck Total			***821682.9857***			**883.1883862**	**0.000715112**	**0.002444268**	**883.8561403**
	Heavy Trucks	***Heavy Trucks***										
HHDTGAS	Riverside (SC)	2025	HHDT	GAS	5.917085626	489.3585501	0.02%	489.3585501	1859.068895	0.072477006	0.0002928	1861.175834
HHDTDSL	Riverside (SC)	2025	HHDT	DSL	16787.91989	2073941.582	99.26%	2073941.582	1220.386579	0.000807626	0.0000000	1220.409193
HHDTNG	Riverside (SC)	2025	HHDT	NG	366.9607711	14928.54824	0.71%	14928.54824	3059.937465	4.302249368	0.0000000	3180.400447
			Heavy-Heavy Truck Total			***2089359.489***			**1233.679825**	**0.031558367**	**6.85703E-08**	**1234.563477**
	Urban Buses	***Urban Buses***										
UBUSGAS	Riverside (SC)	2025	UBUS	GAS	167.3661527	23564.28502	46.25%	23564.28502	1336.205443	0.003566981	0.0570241	1351.4167
UBUSDSL	Riverside (SC)	2025	UBUS	DSL	0.141961099	11.67769301	0.02%	11.67769301	1093.673357	0.037458544	0.0000000	1094.722196
UBUSNG	Riverside (SC)	2025	UBUS	NG	208.7163855	27379.0524	53.73%	27379.0524	1856.440922	5.662736779	0.0000000	2014.997552
			Urban Bus Total			***50955.01511***			**1615.681805**	**3.044349166**	**0.026370941**	**1707.911881**

CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	SOx_RUNEX	SOx_IDLEX	SOx_STREX
0	46.06539707	0.072477006	0	0.000292767	0.133718336	0	0.003629335	0.3359628	0	0.001499214	0.110504271	0.50965202	0.037085039	0.060093787	0.490236128	0	0.00164145	0.110504271	0.50965202	0.037085039	0.060093787	25.13078024	0	5.468566411	0.018396994	0	0.000455854
10932.68307	0	0.000807626	0.214273106	0	0.191827775	1.718465532	0	0.017387967	4.613241217	0	0	0	0	0	0.019794877	5.25182396	0	0	0	0	0	0.15090213	67.8211908	0	0.011529607	0.103286569	0
3592.027107	0	4.302249368	1.209233351	0	0.62378827	0.732258224	0	0.140936561	0.033385466	0	0	0	0	0	4.481302954	1.252464367	0	0	0	0	0	14.30619372	21.84687983	0	0	0	0
0	50.30197489	0.00156859	0	0.04010316	0.003557657	0	0.02310735	0.005490885	0	0.167011827	0.080992061	0.190470615	0.17668152	0.215869853	0.008012287	0	0.182856928	0.080992061	0.190470615	0.17668152	0.215869853	0.518584089	0	1.953005868	0.00237608	0	0.000497779
0	0	0.000409874	0	0	0.028426726	0	0	0.008824337	0	0	0	0	0	0	0.010045921	0	0	0	0	0	0	0.158334389	0	0	0.00170966	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	59.91051375	0.004404957	0	0.061134608	0.006645347	0	0.026484719	0.018755865	0	0.295945624	0.191726207	0.636664928	0.453305455	0.626235047	0.027368514	0	0.324023207	0.191726207	0.636664928	0.453305455	0.626235047	1.001815824	0	2.120806821	0.002785436	0	0.000592863
0	0	0.006936263	0	0	0.058610987	0	0	0.14933365	0	0	0	0	0	0	0.170006432	0	0	0	0	0	0	0.932264491	0	0	0.003525024	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	63.11599525	0.002635444	0	0.055462755	0.004935364	0	0.027796971	0.01012142	0	0.245389702	0.110827506	0.378523762	0.318472854	0.368772897	0.014769152	0	0.268670836	0.110827506	0.378523762	0.318472854	0.368772897	0.706546533	0	2.459241373	0.00288919	0	0.000624584
0	0	0.000566644	0	0	0.037437263	0	0	0.012199505	0	0	0	0	0	0	0.013888326	0	0	0	0	0	0	0.11077608	0	0	0.002251578	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
118.4068454	18.45289293	0.00402855	0.117029361	0.022409645	0.009566676	0.003048852	0.039515296	0.018516269	0.412891886	0.1106008	0.121128572	0.77993358	0.03323602	0.061821438	0.027018897	0.602490871	0.12109397	0.121128572	0.77993358	0.03323602	0.061821438	0.518392968	3.761130761	1.609345788	0.007443613	0.001171732	0.000182606
132.6011947	0	0.003334475	0.005098128	0	0.072599203	0.020843061	0	0.071789278	0.109759705	0	0	0	0	0	0.08172732	0.124954127	0	0	0	0	0	0.471398268	0.909745076	0	0.004366313	0.001253558	0
136.2198426	20.88791884	0.002565587	0.117632977	0.021172439	0.009159471	0.003030928	0.039167717	0.010552342	0.411170728	0.102611938	0.103361362	0.576391237	0.028730783	0.050765668	0.015397952	0.599979361	0.112347156	0.103361362	0.576391237	0.028730783	0.050765668	0.29309399	3.770564255	1.520365092	0.008514824	0.001348006	0.000206703
213.427833	0	0.002903659	0.005098128	0	0.079201938	0.033547883	0	0.062514062	0.109759705	0	0	0	0	0	0.071168104	0.124954127	0	0	0	0	0	0.404748748	0.909745076	0	0.004763419	0.002017661	0
0	59.79585402	0.311277616	0	0.239935839	0.064744013	0	0.014990769	2.09159562	0	1.817336305	0.782062572	1.65908321	1.514593612	2.879023229	2.596338483	0	1.978232889	0.782062572	1.65908321	1.514593612	2.879023229	18.29916334	0	8.680785122	0.002052682	0	0.000591728
0	80.35868142	0.003411775	0	0.068798739	0.006151447	0	0.031241881	0.013500754	0	0.325074208	0.146435308	0.451163759	0.428555893	0.472712282	0.019696643	0	0.355914999	0.146435308	0.451163759	0.428555893	0.472712282	0.804698607	0	2.80678359	0.003657436	0	0.000795214
0	0	0.000390163	0	0	0.051148243	0	0	0.00839997	0	0	0	0	0	0	0.009562808	0	0	0	0	0	0	0.16565094	0	0	0.003076194	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	25.25945019	0.008758762	0	0.031786251	0.021126573	0	0.038421628	0.035578793	0	0.12380774	0.080995856	1.677853456	0.051062934	0.131321208	0.051916491	0	0.135553892	0.080995856	1.677853456	0.051062934	0.131321208	1.030934853	0	2.657870334	0.015860184	0	0.000249963
0	0	0.003164241	0	0	0.14350883	0	0	0.068124237	0	0	0	0	0	0	0.077554914	0	0	0	0	0	0	0.317830044	0	0	0.00863101	0	0
518.8695079	36.10206309	0.005605461	0.264956918	0.034397541	0.013551429	0.007938445	0.028396585	0.026085636	1.009868647	0.179770619	0.068604789	0.337743932	0.021400134	0.037906238	0.038064099	1.473597959	0.1968262	0.068604789	0.337743932	0.021400134	0.037906238	0.685436858	14.43650206	3.832319002	0.015016269	0.005134634	0.000357259
729.9041967	0	0.000341025	0.002967288	0	0.131198737	0.114730775	0	0.007342166	0.063884902	0	0	0	0	0	0.008358497	0.072728098	0	0	0	0	0	0.054883022	2.34753793	0	0.007885562	0.006895773	0
367.8743931	25.6713968	0.008714095	0.194201683	0.028564837	0.018535899	0.005422197	0.024376329	0.042197117	0.745218535	0.151776124	0.032947972	0.367695258	0.029236466	0.065534531	0.061573934	1.087421137	0.166175752	0.032947972	0.367695258	0.029236466	0.065534531	1.097907821	5.768300824	3.175956174	0.01538858	0.003640415	0.000254039
2397.257198	0	0.000483728	0.036457723	0	0.16346782	0.376815448	0	0.010414522	0.784924781	0	0	0	0	0	0.01185614	0.893577113	0	0	0	0	0	0.086090622	12.70438364	0	0.009825062	0.022648097	0
2614.16713	46.99795254	0.008075466	2.365005854	0.05595214	0.021836348	0.083917715	0.054214428	0.040048567	10.64151815	0.327979725	0.088475695	0.535415599	0.024489967	0.048427204	0.058438776	15.5280783	0.359096516	0.088475695	0.535415599	0.024489967	0.048427204	0.905363122	82.24087757	7.300562365	0.008669661	0.025869303	0.000465083
3617.805225	0	0.005132526	0.012315314	0	0.184967014	0.5686686	0	0.110501877	0.26514534	0	0	0	0	0	0.125797975	0.301847787	0	0	0	0	0	0.318716662	6.43661887	0	0.011117248	0.03417923	0
0	50.46145954	0.003566981	0	0.057024082	0.014807346	0	0.052942895	0.010603587	0	0.221790005	0.03419833	0.174937682	0.009464103	0.015510571	0.01547273	0	0.242832138	0.03419833	0.174937682	0.009464103	0.015510571	0.214154059	0	4.248732329	0.013222836	0	0.000499357
0	0	0.037458544	0	0	0.171910221	0	0	0.000535209	0	0	0	0	0	0	0.038229192	0	0	0	0	0	0	0.057172756	0	0	0.010339146	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5.662736779	0	0	0.378447626	0	0	0.080909335	0	0	0	0	0	0	5.779238231	0	0	0	0	0	0	43.76158961	0	0	0	0	0

EMFAC DATA FORECAST YEAR **2030**

Paste data -->

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Region: Riverside (SC)
Calendar Year: 2030
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Helper Column	Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	NOx_RUNEX	NOx_IDLEX	NOx_STREX	PM2.5_RUNEX	PM2.5_IDLEX	PM2.5_STREX	PM2.5_PMTW	PM2.5_PMBW	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW	CO2_RUNEX
HHDTGAS	Riverside (SC)	2030	HHDT	Aggregated	Aggregated	GAS	6.067136543	575.8781518	121.391268	2.756389109	0	0.040590858	0.000889132	0	0.000395572	0.005000001	0.026460008	0.000967012	0	0.000430221	0.02000001	0.06174002	1663.315653
HHDTDSL	Riverside (SC)	2030	HHDT	Aggregated	Aggregated	DSL	17773.29887	2271030.46	191184.1033	1.830489465	55.36842672	2.513755663	0.022899166	0.020692849	0	0.008797199	0.025863765	0.023934565	0.021628488	0	0.0351888	0.06034879	1105.431203
HHDTNG	Riverside (SC)	2030	HHDT	Aggregated	Aggregated	NG	532.4740132	21687.8252	2076.648651	0.73281425	18.56250598	0	0.003310072	0.012130173	0	0.009000003	0.026460008	0.003459739	0.012678646	0	0.03600001	0.06174002	2852.856717
LDAGAS	Riverside (SC)	2030	LDA	Aggregated	Aggregated	GAS	715227.8197	26282324.74	3367539.012	0.019826288	0	0.126594367	0.000832104	0	0.001229871	0.002000001	0.015750005	0.000904989	0	0.001337597	0.008	0.03675001	214.2094479
LDADSL	Riverside (SC)	2030	LDA	Aggregated	Aggregated	DSL	8217.15108	311906.7144	39169.0124	0.016353888	0	0	0.00176593	0	0	0.002000001	0.015750005	0.001845777	0	0	0.008	0.03675001	163.0327464
LDAELEC	Riverside (SC)	2030	LDA	Aggregated	Aggregated	ELEC	31589.03941	1174529.388	154977.4385	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT1GAS	Riverside (SC)	2030	LDT1	Aggregated	Aggregated	GAS	73433.15901	2574226.102	338237.7272	0.043264462	0	0.16239	0.001005485	0	0.001459817	0.002000001	0.015750005	0.001093557	0	0.001587684	0.008	0.03675001	251.6258224
LDT1DSL	Riverside (SC)	2030	LDT1	Aggregated	Aggregated	DSL	9.294707647	328.9266732	42.51634629	0.141592594	0	0	0.009775705	0	0	0.002000001	0.015750005	0.010217719	0	0	0.008	0.03675001	312.9180592
LDT1ELEC	Riverside (SC)	2030	LDT1	Aggregated	Aggregated	ELEC	1718.405366	65233.45576	8487.476192	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT2GAS	Riverside (SC)	2030	LDT2	Aggregated	Aggregated	GAS	221857.6725	7975748.044	1037256.055	0.032798337	0	0.161076084	0.00086015	0	0.001254613	0.002000001	0.015750005	0.000935492	0	0.001364506	0.008	0.03675001	253.80815
LDT2DSL	Riverside (SC)	2030	LDT2	Aggregated	Aggregated	DSL	1944.648271	74491.26436	9364.031571	0.028075231	0	0	0.003711024	0	0	0.002000001	0.015750005	0.003878821	0	0	0.008	0.03675001	215.695914
LDT2ELEC	Riverside (SC)	2030	LDT2	Aggregated	Aggregated	ELEC	6596.872184	171672.0302	32475.58135	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LHDT1GAS	Riverside (SC)	2030	LHDT1	Aggregated	Aggregated	GAS	14719.69829	462837.0738	219301.5722	0.085731837	0.031127677	0.399707436	0.000920978	0	0.000328304	0.002000001	0.032760009	0.001001648	0	0.00035706	0.008	0.07644002	696.2808331
LHDT1DSL	Riverside (SC)	2030	LHDT1	Aggregated	Aggregated	DSL	16082.3234	495405.7507	202295.3968	1.08061356	1.634775047	0	0.011108485	0.025982035	0	0.003000001	0.032760009	0.011610761	0.027156828	0	0.012	0.07644002	425.8257004
LHDT2GAS	Riverside (SC)	2030	LHDT2	Aggregated	Aggregated	GAS	2310.878744	71347.94826	34428.65008	0.077335113	0.031307549	0.407793557	0.000845126	0	0.000282024	0.002000001	0.038220011	0.000919152	0	0.000306726	0.008	0.08918003	798.7232903
LHDT2DSL	Riverside (SC)	2030	LHDT2	Aggregated	Aggregated	DSL	6520.498698	195813.0331	82019.67084	0.934623548	1.652496508	0	0.013892671	0.026392274	0	0.003000001	0.038220011	0.014520836	0.027585616	0	0.012	0.08918003	465.9631392
MCYGAS	Riverside (SC)	2030	MCY	Aggregated	Aggregated	GAS	30660.06028	174391.9176	61320.12055	1.110041527	0	0.262825855	0.00186826	0	0.002518475	0.001	0.005040001	0.00200296	0	0.002692835	0.004	0.01176	207.1386727
MDVGAS	Riverside (SC)	2030	MDV	Aggregated	Aggregated	GAS	159091.2688	5362564.988	730060.1042	0.03984139	0	0.194785369	0.000886036	0	0.001304645	0.002000001	0.015750005	0.000963645	0	0.001418921	0.008	0.03675001	318.0581518
MDVDSL	Riverside (SC)	2030	MDV	Aggregated	Aggregated	DSL	4876.504988	176358.1396	23150.93365	0.019513614	0	0	0.002062228	0	0	0.002000001	0.015750005	0.002155472	0	0	0.008	0.03675001	290.3930762
MDVELEC	Riverside (SC)	2030	MDV	Aggregated	Aggregated	ELEC	4670.491383	123005.7182	23086.60539	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
MHGAS	Riverside (SC)	2030	MH	Aggregated	Aggregated	GAS	3513.615082	27586.6346	351.5020529	0.186406275	0	0.374163733	0.000844179	0	0.000249116	0.003000001	0.055860016	0.000918122	0	0.000270936	0.012	0.13034004	1483.287979
MHDSL	Riverside (SC)	2030	MH	Aggregated	Aggregated	DSL	1869.680968	13149.06474	186.9680968	3.370030291	0	0	0.095846479	0	0	0.004000001	0.055860016	0.100180232	0	0	0.01600001	0.13034004	864.5351266
MHDTGAS	Riverside (SC)	2030	MHDT	Aggregated	Aggregated	GAS	1662.069097	65180.36447	33254.67849	0.12352399	0.090036861	0.3224222	0.00087982	0	0.000380825	0.003000001	0.055860016	0.000956884	0	0.000414182	0.012	0.13034004	1399.943371
MHDTDSL	Riverside (SC)	2030	MHDT	Aggregated	Aggregated	DSL	13927.58228	791350.3068	141662.7816	0.930216518	3.820067762	2.158200075	0.009987888	0.001843198	0	0.003000001	0.055860016	0.010439496	0.001926539	0	0.012	0.13034004	772.1782663
OBUSGAS	Riverside (SC)	2030	OBUS	Aggregated	Aggregated	GAS	439.780953	14096.42165	8799.137307	0.211609938	0.065142963	0.307441326	0.000838757	0	0.000255865	0.003000001	0.055860016	0.000912225	0	0.000278277	0.012	0.13034004	1423.340971
OBUSDSL	Riverside (SC)	2030	OBUS	Aggregated	Aggregated	DSL	276.9150354	18004.47266	2660.54226	1.276138751	11.49552556	2.212386069	0.014862314	0.003717812	0	0.003000001	0.055860016	0.015534321	0.003885915	0	0.012	0.13034004	955.9476518
SBUSGAS	Riverside (SC)	2030	SBUS	Aggregated	Aggregated	GAS	499.496623	16119.6836	1997.986492	0.322753014	0.9265304	0.660225584	0.000848363	0	0.00037281	0.002000001	0.319200087	0.000922672	0	0.000405464	0.008	0.7448002	848.6204813
SBUSDSL	Riverside (SC)	2030	SBUS	Aggregated	Aggregated	DSL	1026.146421	32699.81232	11841.58743	4.521552202	33.20092427	1.314345507	0.024136375	0.023326175	0	0.003000001	0.319200091	0.025227715	0.024380882	0	0.012	0.74480021	1088.127131
UBUSGAS	Riverside (SC)	2030	UBUS	Aggregated	Aggregated	GAS	172.2177935	24247.37084	688.8711739	0.140092389	0	0.466214707	0.001397387	0	0.000589293	0.002386561	0.045038932	0.001519786	0	0.00064091	0.00954624	0.10509084	1239.009708
UBUSDSL	Riverside (SC)	2030	UBUS	Aggregated	Aggregated	DSL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UBUSNG	Riverside (SC)	2030	UBUS	Aggregated	Aggregated	NG	214.9729351	28186.02559	859.8917402	0.442552432	0	0	0.002902192	0	0	0.007354915	0.034520958	0.003033416	0	0	0.02941966	0.0805489	1856.192269

Helper Column	Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
	Passenger Vehicles											
LDADSL	Riverside (SC)	2030	LDA	DSL	8217.15108	311906.7144	0.70%	311906.7144	163.0327464	0.000251968	0.0000000	163.0398015
LDT1DSL	Riverside (SC)	2030	LDT1	DSL	9.294707647	328.9266732	0.00%	328.9266732	312.9180592	0.000991504	0.0000000	312.9458213
LDT2DSL	Riverside (SC)	2030	LDT2	DSL	1944.648271	74491.26436	0.17%	74491.26436	215.695914	0.000544755	0.0000000	215.7111671
MDVDSL	Riverside (SC)	2030	MDV	DSL	4876.504988	176358.1396	0.40%	176358.1396	290.3930762	0.000283086	0.0000000	290.4010026
LDAELEC	Riverside (SC)	2030	LDA	ELEC	31589.03941	1174529.388	2.64%	1174529.388	0	0	0.0000000	0
LDT1ELEC	Riverside (SC)	2030	LDT1	ELEC	1718.405366	65233.45576	0.15%	65233.45576	0	0	0.0000000	0
LDT2ELEC	Riverside (SC)	2030	LDT2	ELEC	6596.872184	171672.0302	0.39%	171672.0302	0	0	0.0000000	0
MDVELEC	Riverside (SC)	2030	MDV	ELEC	4670.491383	123005.7182	0.28%	123005.7182	0	0	0.0000000	0
MCYGAS	Riverside (SC)	2030	MCY	GAS	30660.06028	174391.9176	0.39%	174391.9176	207.1386727	0.306138232	0.2356240	278.1509146
LDAGAS	Riverside (SC)	2030	LDA	GAS	715227.8197	26282324.74	59.11%	26282324.74	214.2094479	0.00103611	0.0293793	222.0239857
LDT1GAS	Riverside (SC)	2030	LDT1	GAS	73433.15901	2574226.102	5.79%	2574226.102	251.6258224	0.002298652	0.0395992	262.1839613
LDT2GAS	Riverside (SC)	2030	LDT2	GAS	221857.6725	7975748.044	17.94%	7975748.044	253.80815	0.00171335	0.0405325	264.5972466
MDVGAS	Riverside (SC)	2030	MDV	GAS	159091.2688	5362564.988	12.06%	5362564.988	318.0581518	0.002056654	0.0476805	330.7510823
			Passenger Vehicle Total			***44466781.43***			**228.5287795**	**0.002505247**	**0.033601554**	**237.5033382**
			Passenger Gasoline Total			**42369255.79**	**95.28%**		**236.1991309**	**0.001365207**	**0.034295198**	**245.3255843**
			Passenger Diesel Total			**563085.045**	**1.27%**		**209.9764155**	**0.000300879**	**0**	**209.9848401**
			Passenger Electric Total			**1534440.592**	**3.45%**		**0**	**0**	**0**	**0**
	Light Trucks											
LHDT1DSL	Riverside (SC)	2030	LHDT1	DSL	16082.3234	495405.7507	40.43%	495405.7507	425.8257004	0.002346804	0.0000000	425.8914109
LHDT2DSL	Riverside (SC)	2030	LHDT2	DSL	6520.498698	195813.0331	15.98%	195813.0331	465.9631392	0.002195095	0.0000000	466.0246019
LHDT1GAS	Riverside (SC)	2030	LHDT1	GAS	14719.69829	462837.0738	37.77%	462837.0738	696.2808331	0.002208449	0.0162381	700.6457686
LHDT2GAS	Riverside (SC)	2030	LHDT2	GAS	2310.878744	71347.94826	5.82%	71347.94826	798.7232903	0.001515617	0.0157468	802.9386243
			Light-Heavy Truck Total			***1225403.806***			**556.1024084**	**0.00222191**	**0.007050002**	**558.0328724**
			Light-Heavy Truck Gasoline Total			**534185.0221**	**43.59%**		**709.963469**	**0.002115912**	**0.016172485**	**714.308423**
			Light-Heavy Truck Diesel Total			**691218.7838**	**56.41%**		**437.1960998**	**0.002303827**	**0**	**437.2606069**
	Medium Trucks											
MHDTGAS	Riverside (SC)	2030	MHDT	GAS	1662.069097	65180.36447	**7.61%**	65180.36447	1399.943371	0.00299992	0.0311156	1408.272993
MHDTDSL	Riverside (SC)	2030	MHDT	DSL	13927.58228	791350.3068	**92.39%**	791350.3068	772.1782663	0.000333355	0.0000000	772.1876002
			Medium-Heavy Truck Total			***856530.6713***			**819.9500037**	**0.000536276**	**0.002367836**	**820.5924959**
	Heavy Trucks											
HHDTGAS	Riverside (SC)	2030	HHDT	GAS	6.067136543	575.8781518	**0.03%**	575.8781518	1663.315653	0.060806204	0.0003069	1665.099552
HHDTDSL	Riverside (SC)	2030	HHDT	DSL	17773.29887	2271030.46	**99.03%**	2271030.46	1105.431203	0.00079181	0.0000000	1105.453374
HHDTNG	Riverside (SC)	2030	HHDT	NG	532.4740132	21687.8252	**0.95%**	21687.8252	2852.856717	4.113584718	0.0000000	2968.037089
			Heavy-Heavy Truck Total			***2293294.163***			**1122.096807**	**0.039701818**	**7.70639E-08**	**1123.208478**
	Urban Buses											
UBUSGAS	Riverside (SC)	2030	UBUS	GAS	172.2177935	24247.37084	**46.24%**	24247.37084	1239.009708	0.003482083	0.0549825	1253.677575
UBUSDSL	Riverside (SC)	2030	UBUS	DSL	0	0	**0.00%**	0	0	0	0.0000000	0
UBUSNG	Riverside (SC)	2030	UBUS	NG	214.9729351	28186.02559	**53.76%**	28186.02559	1856.192269	5.661543863	0.0000000	2014.715497
			Urban Bus Total			***52433.39643***			**1570.78153**	**3.045022112**	**0.025426192**	**1662.78009**

CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	SOx_RUNEX	SOx_IDLEX	SOx_STREX
0	40.53130678	0.060806204	0	0.000306888	0.122902686	0	0.001379204	0.264594509	0	0.001569199	0.060449121	0.274649934	0.021249665	0.033441898	0.386095686	0	0.001718076	0.060449121	0.274649934	0.021249665	0.033441898	24.88201336	0	4.845915526	0.016459857	0	0.00040109
10066.05439	0	0.00079181	0.214753714	0	0.173758391	1.582243572	0	0.017047444	4.623588578	0	0	0	0	0	0.019407217	5.263603642	0	0	0	0	0	0.149552454	68.13030084	0	0.010443566	0.095099091	0
3339.386198	0	4.113584718	1.179354649	0	0.581573504	0.680755722	0	0.091947863	0.02358105	0	0	0	0	0	4.236011433	1.211286408	0	0	0	0	0	14.52518943	22.02459439	0	0	0	0
0	44.65562506	0.00103611	0	0.029379346	0.003075847	0	0.02016992	0.003376418	0	0.116991497	0.065910657	0.174903115	0.143082152	0.170528324	0.004926861	0	0.128090963	0.065910657	0.174903115	0.143082152	0.170528324	0.438662802	0	1.670838632	0.002119776	0	0.000441904
0	0	0.000251968	0	0	0.025626477	0	0	0.005424712	0	0	0	0	0	0	0.006175674	0	0	0	0	0	0	0.13498492	0	0	0.001541246	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	53.03695357	0.002298652	0	0.039599157	0.004464638	0	0.022218444	0.009229522	0	0.177750924	0.125724553	0.435042216	0.311501611	0.405270163	0.013467697	0	0.194614888	0.125724553	0.435042216	0.311501611	0.405270163	0.652048609	0	1.77653362	0.002490041	0	0.000524844
0	0	0.000991504	0	0	0.049186361	0	0	0.021346502	0	0	0	0	0	0	0.024301573	0	0	0	0	0	0	0.201736589	0	0	0.002958201	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	54.62850344	0.00171335	0	0.040532539	0.003748427	0	0.022790055	0.006203329	0	0.171084682	0.087434828	0.317429208	0.271041511	0.306204331	0.009051883	0	0.187316192	0.087434828	0.317429208	0.271041511	0.306204331	0.566125401	0	2.148438951	0.002511637	0	0.000540593
0	0	0.000544755	0	0	0.033904394	0	0	0.011728255	0	0	0	0	0	0	0.013351839	0	0	0	0	0	0	0.115078741	0	0	0.002039102	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
111.1756325	17.38729936	0.002208449	0.10479815	0.016238109	0.005951617	0.002851923	0.034289495	0.009245859	0.357017559	0.077706702	0.101953362	0.748524306	0.028485997	0.050814573	0.013491536	0.520959185	0.085079057	0.101953362	0.748524306	0.028485997	0.050814573	0.278019202	3.768706975	1.496861445	0.006890263	0.001100173	0.000172061
123.8645975	0	0.002346804	0.005098128	0	0.06693387	0.01946979	0	0.050525306	0.109759705	0	0	0	0	0	0.057519702	0.124954127	0	0	0	0	0	0.309248204	0.909745076	0	0.004025584	0.001170966	0
128.1495867	19.72416034	0.001515617	0.10577222	0.01574678	0.006001028	0.002831184	0.034497807	0.005626915	0.35942206	0.073966688	0.081984954	0.437985045	0.025211546	0.04147514	0.008210781	0.524467827	0.080984213	0.081984954	0.437985045	0.025211546	0.04147514	0.166883286	3.777246523	1.417227435	0.007904014	0.001268144	0.000195187
200.0118023	0	0.002195095	0.005098128	0	0.073242917	0.03143907	0	0.047259102	0.109759705	0	0	0	0	0	0.053801345	0.124954127	0	0	0	0	0	0.284451163	0.909745076	0	0.004405027	0.001890831	0
0	58.56376794	0.306138232	0	0.235624043	0.064276432	0	0.014988703	2.04027206	0	1.782020276	0.761134687	1.404294963	1.489106083	2.883443968	2.55138921	0	1.940574247	0.761134687	1.404294963	1.489106083	2.883443968	17.43059513	0	8.766900296	0.002049805	0	0.000579536
0	69.032068	0.002056654	0	0.047680544	0.00427281	0	0.024834912	0.007682947	0	0.213008029	0.119996729	0.382900908	0.389491026	0.425895931	0.011210938	0	0.23321698	0.119996729	0.382900908	0.389491026	0.425895931	0.60652064	0	2.32766502	0.003147443	0	0.000683128
0	0	0.000283086	0	0	0.045645748	0	0	0.006094676	0	0	0	0	0	0	0.006938384	0	0	0	0	0	0	0.149696547	0	0	0.002745259	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	23.64405007	0.004670125	0	0.030295302	0.015720884	0	0.042801838	0.01556689	0	0.112061705	0.058924719	1.004962773	0.041134478	0.096162757	0.02271517	0	0.122693461	0.058924719	1.004962773	0.041134478	0.096162757	0.351236962	0	2.372222509	0.014678337	0	0.000233977
0	0	0.002748042	0	0	0.135892883	0	0	0.059163734	0	0	0	0	0	0	0.067353978	0	0	0	0	0	0	0.266878487	0	0	0.008172966	0	0
484.1037713	32.97416827	0.00299992	0.268769818	0.031115564	0.00921011	0.00822116	0.028474336	0.012652048	1.014122687	0.156297481	0.055408482	0.263734763	0.018603147	0.030611986	0.018461839	1.479805444	0.171126069	0.055408482	0.263734763	0.018603147	0.030611986	0.301664017	14.4839326	3.224915772	0.013853575	0.004790599	0.000326306
663.7380671	0	0.000333355	0.002724436	0	0.12137567	0.104330381	0	0.007177041	0.05865636	0	0	0	0	0	0.008170514	0.066775801	0	0	0	0	0	0.055178768	2.353510012	0	0.007295157	0.006270668	0
345.7784114	23.80282788	0.004627149	0.195915946	0.026305166	0.012435664	0.005566945	0.02459023	0.020918058	0.747522566	0.137146043	0.031356311	0.365931302	0.026995939	0.057645887	0.030523582	1.090783173	0.150157655	0.031356311	0.365931302	0.026995939	0.057645887	0.519199098	5.78210788	2.818443558	0.014085113	0.003421758	0.000235548
2335.619372	0	0.000481657	0.037991742	0	0.150261659	0.36712684	0	0.010369951	0.817951789	0	0	0	0	0	0.0118054	0.931175848	0	0	0	0	0	0.085677561	13.1810004	0	0.009031319	0.022065774	0
2538.421096	45.58378575	0.006614099	2.352753757	0.056485865	0.020732609	0.083211485	0.057343143	0.032631047	10.64151815	0.331746358	0.109280967	0.656879912	0.030503503	0.059721273	0.047615148	15.5280783	0.363220505	0.109280967	0.656879912	0.030503503	0.059721273	0.73418846	82.24087757	7.07323596	0.008397788	0.025119735	0.000451089
3372.952702	0	0.00402809	0.012315443	0	0.171038432	0.530181194	0	0.086723677	0.265148114	0	0	0	0	0	0.098728305	0.301850944	0	0	0	0	0	0.27469559	7.931816063	0	0.010280086	0.031865985	0
0	47.0592714	0.003482083	0	0.054982523	0.014397721	0	0.050775007	0.010351234	0	0.211471449	0.043369187	0.202330491	0.012386636	0.019758457	0.015104497	0	0.231534619	0.043369187	0.202330491	0.012386636	0.019758457	0.209953403	0	4.177699374	0.012261005	0	0.00046569
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5.661543863	0	0	0.378396937	0	0	0.080892291	0	0	0	0	0	0	5.778020772	0	0	0	0	0	0	43.75129964	0	0	0	0	0

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Paste data --> Region: Riverside (SC)
Calendar Year: 2040
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day

	Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	NOx_RUNEX	NOx_IDLEX	NOx_STREX	PM2.5_RUNEX	PM2.5_IDLEX	PM2.5_STREX	PM2.5_PMTW	PM2.5_PMBW	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW	CO2_RUNEX
	Riverside (SC)		2040 HHDT	Aggregated	Aggregated	GAS	8.124886922	694.511498		162.5627375	2.897257867	0	0.230472949	0.000910466	0	0.000398988	0.005000001	0.026460008	0.000990215	0	0.000433936	0.02000001	0.06174002	1503.675531
Helper Column	**Riverside (SC)**	**2040**	**HHDT**	**Aggregated**	**Aggregated2**	**DSL**	**18618.69407**	**2606721.375**	**204419.8195**	**1.68437187**	**57.70939899**	**2.515864344**	**0.021265614**	**0.020126074**	**0**	**0.008794529**	**0.025855915**	**0.022227151**	**0.021036086**	**03**	**0.035178115**	**0.060330468**	**953.7673638**
HHDTNG	Riverside (SC)		2040 HHDT	Aggregated	Aggregated	NG	752.7479905	30682.87514		2935.717163	0.503075055	17.99082503	0	0.003045145	0.008114607	0	0.009000003	0.026460008	0.003182833	0.008481513	0	0.03600001	0.06174002	2619.087599
LDAGAS	Riverside (SC)		2040 LDA	Aggregated	Aggregated	GAS	852555.6492	28828531.06		3992443.135	0.016977753	0	0.114109609	0.000495953	0	0.000737941	0.002000001	0.015750005	0.000539394	0	0.000802578	0.008	0.03675001	193.7559849
LDADSL	Riverside (SC)		2040 LDA	Aggregated	Aggregated	DSL	10443.92772	357353.0917		49163.70723	0.008668227	0	0	0.00079023	0	0	0.002000001	0.015750005	0.000825961	0	0	0.008	0.03675001	149.4381893
LDAELEC	Riverside (SC)		2040 LDA	Aggregated	Aggregated	ELEC	52845.7585	1674934.107		251487.5439	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT1GAS	Riverside (SC)		2040 LDT1	Aggregated	Aggregated	GAS	90264.3132	2917283.683		415139.7563	0.019776261	0	0.126764124	0.000554965	0	0.000826875	0.002000001	0.015750005	0.000603575	0	0.000899302	0.008	0.03675001	225.7546335
LDT1DSL	Riverside (SC)		2040 LDT1	Aggregated	Aggregated	DSL	12.06522994	397.7699388		56.06289505	0.03946062	0	0	0.004206022	0	0	0.002000001	0.015750005	0.0043962	0	0	0.008	0.03675001	284.6987673
LDT1ELEC	Riverside (SC)		2040 LDT1	Aggregated	Aggregated	ELEC	3205.210505	100693.5818		15205.77842	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT2GAS	Riverside (SC)		2040 LDT2	Aggregated	Aggregated	GAS	267281.1831	8853193.744		1242641.877	0.019110238	0	0.123218329	0.000514666	0	0.000755635	0.002000001	0.015750005	0.000559746	0	0.000821822	0.008	0.03675001	223.0213349
LDT2DSL	Riverside (SC)		2040 LDT2	Aggregated	Aggregated	DSL	2669.202637	90290.35875		12564.36276	0.027153166	0	0	0.003839773	0	0	0.002000001	0.015750005	0.00401339	0	0	0.008	0.03675001	198.1276981
LDT2ELEC	Riverside (SC)		2040 LDT2	Aggregated	Aggregated	ELEC	11506.89393	252074.9044		54727.42969	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LHDT1GAS	Riverside (SC)		2040 LHDT1	Aggregated	Aggregated	GAS	16331.79402	490932.6532		243319.3965	0.032499979	0.02508139	0.294344286	0.00090524	0	0.000302246	0.002000001	0.032760009	0.000984531	0	0.000328721	0.008	0.07644002	636.5296282
LHDT1DSL	Riverside (SC)		2040 LHDT1	Aggregated	Aggregated	DSL	17335.07519	509105.1029		218053.4383	0.237983978	1.070357746	0	0.005956798	0.026267843	0	0.003000001	0.032760009	0.006226138	0.027455558	0	0.012	0.07644002	383.648813
LHDT2GAS	Riverside (SC)		2040 LHDT2	Aggregated	Aggregated	GAS	2556.874497	75450.55392		38093.62027	0.036114377	0.025064012	0.291939128	0.000894611	0	0.000292547	0.002000001	0.038220011	0.000972971	0	0.000318172	0.008	0.08918003	730.6320516
LHDT2DSL	Riverside (SC)		2040 LHDT2	Aggregated	Aggregated	DSL	7240.680011	202538.2176		91078.64576	0.34517404	1.138711104	0	0.011665852	0.026214228	0	0.003000001	0.038220011	0.01219333	0.027399519	0	0.012	0.08918003	421.7609039
MCYGAS	Riverside (SC)		2040 MCY	Aggregated	Aggregated	GAS	34845.94277	182904.0071		69691.88555	1.102244205	0	0.262807771	0.001996647	0	0.002708296	0.001	0.005040001	0.002141629	0	0.0029024	0.004	0.01176	206.6752722
MDVGAS	Riverside (SC)		2040 MDV	Aggregated	Aggregated	GAS	179699.1479	5676216.57		824712.5138	0.022553453	0	0.142080935	0.00054115	0	0.00080511	0.002000001	0.015750005	0.00058855	0	0.000875631	0.008	0.03675001	272.7681005
MDVDSL	Riverside (SC)		2040 MDV	Aggregated	Aggregated	DSL	6247.352713	202958.1774		29135.98582	0.010217801	0	0	0.000985897	0	0	0.002000001	0.015750005	0.001030474	0	0	0.008	0.03675001	259.7295165
MDVELEC	Riverside (SC)		2040 MDV	Aggregated	Aggregated	ELEC	8569.582824	187584.8748		40751.38161	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
MHGAS	Riverside (SC)		2040 MH	Aggregated	Aggregated	GAS	2983.257089	24721.90276		298.4450392	0.10052677	0	0.353812638	0.000874967	0	0.000273275	0.003000001	0.055860016	0.000951606	0	0.000297211	0.012	0.13034004	1325.260137
MHDSL	Riverside (SC)		2040 MH	Aggregated	Aggregated	DSL	1687.17327	11766.32886		168.717327	2.2409846	0	0	0.048536039	0	0	0.004000001	0.055860016	0.050730623	0	0	0.016	0.13034004	788.2896076
MHDTGAS	Riverside (SC)		2040 MHDT	Aggregated	Aggregated	GAS	2095.927505	74872.81877		41935.31751	0.083111262	0.090189281	0.327568541	0.000907295	0	0.000394951	0.003000001	0.055860016	0.000986766	0	0.000429545	0.012	0.13034004	1289.319558
MHDTDSL	Riverside (SC)		2040 MHDT	Aggregated	Aggregated	DSL	14920.90135	847358.4654		155430.3819	0.876523717	3.374785136	2.162233005	0.009428075	0.000903233	0	0.003000001	0.055860016	0.00985437	0.000944073	0	0.012	0.13034004	699.6805114
OBUSGAS	Riverside (SC)		2040 OBUS	Aggregated	Aggregated	GAS	493.5220247	14946.53169		9874.38867	0.125143833	0.065297017	0.29492544	0.000897123	0	0.000271656	0.003000001	0.055860016	0.000975703	0	0.00029545	0.012	0.13034004	1301.988541
OBUSDSL	Riverside (SC)		2040 OBUS	Aggregated	Aggregated	DSL	305.0416488	19882.7848		2915.060062	1.19075697	11.12694733	2.221303898	0.013837013	0.003588303	0	0.003000001	0.055860016	0.014462661	0.00375055	0	0.012	0.13034004	878.7930039
SBUSGAS	Riverside (SC)		2040 SBUS	Aggregated	Aggregated	GAS	452.1810879	13603.01699		1808.724352	0.150387552	0.9265304	0.649029011	0.001252564	0	0.00056523	0.002000001	0.319200087	0.001362278	0	0.000614739	0.008	0.7448002	763.5198722
SBUSDSL	Riverside (SC)		2040 SBUS	Aggregated	Aggregated	DSL	1158.764484	37047.88258		13371.98149	1.975839665	16.93858292	2.034479569	0.005639959	0.004570321	0	0.003000001	0.319200091	0.005894973	0.004776971	0	0.012	0.74480021	918.4982486
UBUSGAS	Riverside (SC)		2040 UBUS	Aggregated	Aggregated	GAS	181.921075	25613.54248		727.6843	0.159206825	0	0.481911826	0.001398566	0	0.000589391	0.002386561	0.045038932	0.001521068	0	0.000641017	0.00954624	0.10509084	1103.539732
UBUSDSL	Riverside (SC)		2040 UBUS	Aggregated	Aggregated	DSL	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UBUSNG	Riverside (SC)		2040 UBUS	Aggregated	Aggregated	NG	227.0851731	29774.11319		908.3406924	0.443039317	0	0	0.002900574	0	0	0.007354915	0.034520958	0.003031726	0	0	0.02941966	0.0805489	1857.673012

Helper Column	Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
	Passenger Vehicles											
LDADSL	Riverside (SC)	2040	LDA	DSL	10443.92772	357353.0917	0.72%	357353.0917	149.4381893	0.000179292	0.0000000	149.4432095
LDT1DSL	Riverside (SC)	2040	LDT1	DSL	12.06522994	397.7699388	0.00%	397.7699388	284.6987673	0.000585582	0.0000000	284.7151636
LDT2DSL	Riverside (SC)	2040	LDT2	DSL	2669.202637	90290.35875	0.18%	90290.35875	198.1276981	0.000559656	0.0000000	198.1433685
MDVDSL	Riverside (SC)	2040	MDV	DSL	6247.352713	202958.1774	0.41%	202958.1774	259.7295165	0.000205016	0.0000000	259.7352569
LDAELEC	Riverside (SC)	2040	LDA	ELEC	52845.7585	1674934.107	3.40%	1674934.107	0	0	0.0000000	0
LDT1ELEC	Riverside (SC)	2040	LDT1	ELEC	3205.210505	100693.5818	0.20%	100693.5818	0	0	0.0000000	0
LDT2ELEC	Riverside (SC)	2040	LDT2	ELEC	11506.89393	252074.9044	0.51%	252074.9044	0	0	0.0000000	0
MDVELEC	Riverside (SC)	2040	MDV	ELEC	8569.582824	187584.8748	0.38%	187584.8748	0	0	0.0000000	0
MCYGAS	Riverside (SC)	2040	MCY	GAS	34845.94277	182904.0071	0.37%	182904.0071	206.6752722	0.302853447	0.2311250	276.4033052
LDAGAS	Riverside (SC)	2040	LDA	GAS	852555.6492	28828531.06	58.45%	28828531.06	193.7559849	0.000648263	0.0197320	199.0031097
LDT1GAS	Riverside (SC)	2040	LDT1	GAS	90264.3132	2917283.683	5.91%	2917283.683	225.7546335	0.000805763	0.0219859	231.6034561
LDT2GAS	Riverside (SC)	2040	LDT2	GAS	267281.1831	8853193.744	17.95%	8853193.744	223.0213349	0.000947656	0.0266396	230.1073604
MDVGAS	Riverside (SC)	2040	MDV	GAS	179699.1479	5676216.57	11.51%	5676216.57	272.7681005	0.001063768	0.0296162	280.6461861
			Passenger Vehicle Total			***49324415.93***			**201.2989486**	**0.001845265**	**0.021879837**	**207.1487729**
			Passenger Gasoline Total			**46458129.07**	**94.19%**		**210.233017**	**0.00076342**	**0.022319807**	**216.1691417**
			Passenger Diesel Total			**650999.3978**	**1.32%**		**190.6586922**	**0.000240315**	**0**	**190.665421**
			Passenger Electric Total			**2215287.468**	**4.49%**		**0**	**0**	**0**	**0**
	Light Trucks											
LHDT1DSL	Riverside (SC)	2040	LHDT1	DSL	17335.07519	509105.1029	39.84%	509105.1029	383.648813	0.00147682	0.0000000	383.6901639
LHDT2DSL	Riverside (SC)	2040	LHDT2	DSL	7240.680011	202538.2176	15.85%	202538.2176	421.7609039	0.001599136	0.0000000	421.8056797
LHDT1GAS	Riverside (SC)	2040	LHDT1	GAS	16331.79402	490932.6532	38.41%	490932.6532	636.5296282	0.000923188	0.0106675	639.3823581
LHDT2GAS	Riverside (SC)	2040	LHDT2	GAS	2556.874497	75450.55392	5.90%	75450.55392	730.6320516	0.000917134	0.0099741	733.3008703
			Light-Heavy Truck Total			***1278026.528***			**507.3134464**	**0.001250494**	**0.004686572**	**508.5904019**
			Light-Heavy Truck Gasoline Total			**566383.2071**	**44.32%**		**649.0654518**	**0.000922381**	**0.010575108**	**651.8936821**
			Light-Heavy Truck Diesel Total			**711643.3205**	**55.68%**		**394.4957566**	**0.001511632**	**0**	**394.5380823**
	Medium Trucks											
MHDTGAS	Riverside (SC)	2040	MHDT	GAS	2095.927505	74872.81877	**8.12%**	74872.81877	1289.319558	0.002132158	0.0298372	1297.28612
MHDTDSL	Riverside (SC)	2040	MHDT	DSL	14920.90135	847358.4654	**91.88%**	847358.4654	699.6805114	0.00031952	0.0000000	699.689458
			Medium-Heavy Truck Total			***922231.2842***			**747.5512985**	**0.000466682**	**0.002422382**	**748.2062968**
	Heavy Trucks											
HHDTGAS	#N/A	#N/A	HHDT	GAS	0	0	**0.00%**	0	0	0	0.0000000	0
HHDTDSL	#N/A	#N/A	HHDT	DSL	0	0	**0.00%**	0	0	0	0.0000000	0
HHDTNG	Riverside (SC)	2040	HHDT	NG	752.7479905	30682.87514	**100.00%**	30682.87514	2619.087599	4.023427451	0.0000000	2731.743568
			Heavy-Heavy Truck Total			***30682.87514***			**2619.087599**	**4.023427451**	**0**	**2731.743568**
	Urban Buses											
UBUSGAS	Riverside (SC)	2040	UBUS	GAS	181.921075	25613.54248	**46.24%**	25613.54248	1103.539732	0.003418268	0.0590540	1119.284745
UBUSDSL	Riverside (SC)	2040	UBUS	DSL	0	0	**0.00%**	0	0	0	0.0000000	0
UBUSNG	Riverside (SC)	2040	UBUS	NG	227.0851731	29774.11319	**53.76%**	29774.11319	1857.673012	5.667455554	0.0000000	2016.361768
			Urban Bus Total			***55387.65567***			**1508.930597**	**3.048170483**	**0.027308996**	**1601.516255**

CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	SOx_RUNEX	SOx_IDLEX	SOx_STREX
0	35.74625828	0.06203429		0	0.000271584	0.127288702		0	0.010623108	0.268646119	0	0.001374946	0.049915787	0.239664972	0.019310779	0.029797871	0.392007786	0	0.001505393	0.049915787	0.239664972	0.019310779	0.029797871	26.22300794	0	4.686527085	0.014880088	0	0.000353738
9339.765129	**04**	**0.000761106**	**0.225901139**	**05**	**0.149918948**	**1.468081014**	**06**	**0.016386396**	**4.863589569**	**07**	**08**	**09**	**010**	**011**	**0.018654665**	**5.536826502**	**012**	**013**	**014**	**015**	**016**	**0.147647479**	**71.82116096**	**017**	**0.009010721**	**0.08823747**	**018**
3061.31218	0	4.023427451	1.165236263	0	0.533918141	0.624068514	0	0.068247994	0.018835201	0	0	0	0	0	4.118463873	1.191700072	0	0	0	0	0	14.63207193	22.12471068	0	0	0	0
0	39.59777333	0.000648263	0	0.019731975	0.002883082	0	0.01883933	0.001838008	0	0.071755653	0.041448307	0.155159102	0.091673395	0.101257002	0.002682017	0	0.078563409	0.041448307	0.155159102	0.091673395	0.101257002	0.386397323	0	1.408850329	0.001917373	0	0.000391852
0	0	0.000179292	0	0	0.023489602	0	0	0.003860052	0	0	0	0	0	0	0.004394413	0	0	0	0	0	0	0.123430879	0	0	0.001412728	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	46.52513947	0.000805763	0	0.021985891	0.003105487	0	0.020121694	0.002482157	0	0.082785435	0.058613077	0.22099014	0.158165003	0.170121872	0.003621958	0	0.090639631	0.058613077	0.22099014	0.158165003	0.170121872	0.410210173	0	1.471981044	0.002234025	0	0.000460404
0	0	0.000585582	0	0	0.044750682	0	0	0.012607228	0	0	0	0	0	0	0.014352491	0	0	0	0	0	0	0.132331433	0	0	0.002691427	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	47.02696359	0.000947656	0	0.026639589	0.002972565	0	0.019834145	0.002911668	0	0.10187685	0.053331343	0.204818756	0.186121795	0.200654063	0.004248699	0	0.111542328	0.053331343	0.204818756	0.186121795	0.200654063	0.458699378	0	1.858289718	0.002206977	0	0.00046537
0	0	0.000559656	0	0	0.031142915	0	0	0.012049059	0	0	0	0	0	0	0.013717053	0	0	0	0	0	0	0.123894304	0	0	0.001873019	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
101.0265158	15.83387686	0.000923188	0.088827248	0.010667474	0.003168983	0.002537291	0.028861676	0.002933194	0.288068334	0.046850158	0.061436811	0.297792151	0.022187801	0.034640983	0.004280109	0.420348637	0.051295026	0.061436811	0.297792151	0.022187801	0.034640983	0.107085656	3.781397237	1.358457256	0.006298977	0.000999739	0.000156689
110.2665763	0	0.00147682	0.005098128	0	0.060304251	0.01733237	0	0.031795065	0.109759705	0	0	0	0	0	0.036196568	0.124954127	0	0	0	0	0	0.162555892	0.909745076	0	0.003626861	0.001042416	0
116.3597416	18.07908931	0.000917134	0.089077308	0.009974109	0.003564743	0.002515222	0.028530808	0.002903841	0.287868738	0.042691083	0.054512029	0.270883064	0.021338186	0.032883111	0.004237278	0.420057387	0.046741362	0.054512029	0.270883064	0.021338186	0.032883111	0.105726124	3.781397237	1.353599994	0.007230196	0.001151474	0.000178907
180.3187885	0	0.001599136	0.005098128	0	0.066294941	0.028343602	0	0.03442846	0.109759705	0	0	0	0	0	0.039194512	0.124954127	0	0	0	0	0	0.181260142	0.909745076	0	0.003987157	0.001704661	0
0	57.21662262	0.302853447	0	0.231125043	0.063846482	0	0.014954659	2.011431567	0	1.750859042	0.740140947	1.219100492	1.462606406	2.895489041	2.524403501	0	1.907397194	0.740140947	1.219100492	1.462606406	2.895489041	16.72139177	0	8.870886869	0.002045219	0	0.000566205
0	58.10231918	0.001063768	0	0.029616227	0.003210369	0	0.02120621	0.003405667	0	0.119098799	0.083143409	0.242362045	0.306926008	0.328876707	0.004969542	0	0.130398194	0.083143409	0.242362045	0.306926008	0.328876707	0.473564028	0	1.945117057	0.002699261	0	0.00057497
0	0	0.000205016	0	0	0.040825863	0	0	0.004413881	0	0	0	0	0	0	0.00502491	0	0	0	0	0	0	0.137420012	0	0	0.002455378	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	20.92212521	0.002941268	0	0.028559413	0.011897797	0	0.041960673	0.008093515	0	0.099835883	0.028429077	0.325668354	0.027180026	0.054450721	0.011810039	0	0.109307725	0.028429077	0.325668354	0.027180026	0.054450721	0.156020082	0	2.129411696	0.013114523	0	0.000207041
0	0	0.001887717	0	0	0.123908149	0	0	0.040641427	0	0	0	0	0	0	0.046267563	0	0	0	0	0	0	0.158841336	0	0	0.007452172	0	0
443.1393193	29.87735368	0.002132158	0.267287841	0.029837217	0.007463035	0.008125138	0.029343186	0.008080244	1.016330693	0.146855749	0.047844395	0.228626823	0.018416218	0.028546035	0.011790673	1.483027361	0.16078856	0.047844395	0.228626823	0.018416218	0.028546035	0.171293862	14.50860793	2.839766292	0.012758862	0.004385223	0.000295661
585.9779084	0	0.00031952	0.002625776	0	0.109980033	0.092107567	0	0.006879183	0.056532238	0	0	0	0	0	0.007831427	0.06435765	0	0	0	0	0	0.054946235	2.376620696	0	0.006610235	0.005536029	0
318.0759553	21.69462723	0.003006724	0.195770953	0.024492215	0.009314554	0.00558933	0.024393881	0.012508219	0.74980715	0.125497296	0.029468027	0.328642842	0.026349515	0.053029493	0.018251964	1.094116833	0.137403743	0.029468027	0.328642842	0.026349515	0.053029493	0.288123033	5.79590819	2.50368565	0.012884232	0.003147619	0.000214686
2047.57235	0	0.000468903	0.036468785	0	0.138134022	0.321849859	0	0.010095356	0.785162946	0	0	0	0	0	0.011492795	0.893848246	0	0	0	0	0	0.084923005	12.70782063	0	0.008302401	0.019344448	0
2303.707561	41.34581731	0.002603345	2.34192554	0.051486011	0.013331897	0.087826936	0.057423233	0.011829833	10.64151815	0.300607327	0.102260256	0.645488628	0.030967715	0.060720509	0.017262064	15.5280783	0.329127185	0.102260256	0.645488628	0.030967715	0.060720509	0.217663344	82.24087757	6.550385455	0.007555648	0.022797054	0.00040915
2845.379449	0	0.001040071	0.012609333	0	0.144375134	0.447254025	0	0.022392435	0.271475491	0	0	0	0	0	0.025492083	0.309054182	0	0	0	0	0	0.148658789	10.91645777	0	0.008677516	0.026881734	0
0	42.9991611	0.003418268	0	0.059053966	0.015642855	0	0.050615358	0.010159383	0	0.228238723	0.056801582	0.294870764	0.015293043	0.023885705	0.014824547	0	0.249892672	0.056801582	0.294870764	0.015293043	0.023885705	0.229087225	0	4.150417705	0.01092042	0	0.000425512
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5.667455554	0	0	0.378698796	0	0	0.080976757	0	0	0	0	0	0	5.784054087	0	0	0	0	0	0	43.77692612	0	0	0	0	0

EMFAC DATA FORECAST YEAR **2045**

Paste data -->

EMFAC2017 (v1.0.2) Emission Rates
Region Type: Sub-Area
Region: Riverside (SC)
Calendar Year: 2045
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Helper Column	Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	NOx_RUNEX	NOx_IDLEX	NOx_STREX	PM2.5_RUNEX	PM2.5_IDLEX	PM2.5_STREX	PM2.5_PMTW	PM2.5_PMBW	PM10_RUNEX	PM10_IDLEX	PM10_STREX	PM10_PMTW	PM10_PMBW	CO2_RUNEX
HHDTGAS	Riverside (SC)	2045	HHDT	Aggregated	Aggregated	GAS	8.877764033	726.7370788	177.6263028	2.934663154	0	1.227379152	0.000911343	0	0.000401569	0.005000001	0.026460008	0.000991169	0	0.000436743	0.02000001	0.06174002	1485.446747
HHDTDSL	Riverside (SC)	2045	HHDT	Aggregated	Aggregated	DSL	19771.30613	2780447.525	217566.651	1.671732441	58.15102141	2.509248224	0.021308299	0.020141412	0	0.008796264	0.025861017	0.022271765	0.021052118	0	0.03518506	0.06034237	927.4186026
HHDTNG	Riverside (SC)	2045	HHDT	Aggregated	Aggregated	NG	815.1095049	33231.43013	3178.927069	0.451898303	17.87617346	0	0.002965356	0.007139165	0	0.009000003	0.026460008	0.003099436	0.007461966	0	0.03600001	0.06174002	2566.574632
LDAGAS	Riverside (SC)	2045	LDA	Aggregated	Aggregated	GAS	913041.1954	29936920.33	4270004.783	0.016762374	0	0.114170557	0.000443279	0	0.000641075	0.002000001	0.015750005	0.000482106	0	0.000697227	0.008	0.03675001	191.3565906
LDADSL	Riverside (SC)	2045	LDA	Aggregated	Aggregated	DSL	11293.09269	372770.2538	52981.43862	0.007863792	0	0	0.000683755	0	0	0.002000001	0.015750005	0.000714671	0	0	0.008	0.03675001	147.8706363
LDAELEC	Riverside (SC)	2045	LDA	Aggregated	Aggregated	ELEC	59370.65147	1789142.326	280210.5535	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT1GAS	Riverside (SC)	2045	LDT1	Aggregated	Aggregated	GAS	97601.24874	3053548.556	447992.7338	0.018078909	0	0.12492393	0.000482532	0	0.000700613	0.002000001	0.015750005	0.000524798	0	0.000761981	0.008	0.03675001	220.9610655
LDT1DSL	Riverside (SC)	2045	LDT1	Aggregated	Aggregated	DSL	13.36988892	423.1438278	61.78023564	0.030060894	0	0	0.004018207	0	0	0.002000001	0.015750005	0.004199892	0	0	0.008	0.03675001	280.297165
LDT1ELEC	Riverside (SC)	2045	LDT1	Aggregated	Aggregated	ELEC	3760.389977	110270.4539	17576.87295	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LDT2GAS	Riverside (SC)	2045	LDT2	Aggregated	Aggregated	GAS	286641.7728	9212604.061	1331164.16	0.016947962	0	0.118118207	0.000458037	0	0.000657003	0.002000001	0.015750005	0.000498157	0	0.00071455	0.008	0.03675001	218.5158177
LDT2DSL	Riverside (SC)	2045	LDT2	Aggregated	Aggregated	DSL	2922.745156	95055.81694	13674.76376	0.027060605	0	0	0.003867772	0	0	0.002000001	0.015750005	0.004042656	0	0	0.008	0.03675001	195.8471726
LDT2ELEC	Riverside (SC)	2045	LDT2	Aggregated	Aggregated	ELEC	13044.94563	270545.539	61436.42034	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
LHDT1GAS	Riverside (SC)	2045	LHDT1	Aggregated	Aggregated	GAS	17385.47919	508957.9371	259017.7355	0.086674669	0.023779254	0.296317957	0.000909842	0	0.000301649	0.002000001	0.032760009	0.000989536	0	0.000328071	0.008	0.07644002	625.5191515
LHDT1DSL	Riverside (SC)	2045	LHDT1	Aggregated	Aggregated	DSL	18251.48509	524334.345	229580.7221	0.103706007	0.920566481	0	0.0049423	0.026361106	0	0.003000001	0.032760009	0.005165769	0.027553038	0	0.012	0.07644002	374.5174276
LHDT2GAS	Riverside (SC)	2045	LHDT2	Aggregated	Aggregated	GAS	2730.304577	78385.83641	40677.47005	0.100801525	0.023597681	0.2873297	0.000907986	0	0.000298993	0.002000001	0.038220011	0.000987518	0	0.000325182	0.008	0.08918003	717.0096924
LHDT2DSL	Riverside (SC)	2045	LHDT2	Aggregated	Aggregated	DSL	7719.58461	209370.591	97102.66315	0.222172022	1.015345605	0	0.011358403	0.026274622	0	0.003000001	0.038220011	0.011871979	0.027462643	0	0.012	0.08918003	412.2775702
MCYGAS	Riverside (SC)	2045	MCY	Aggregated	Aggregated	GAS	37096.05585	188809.8895	74192.1117	1.101201558	0	0.263134606	0.002015761	0	0.002750869	0.001	0.005040001	0.002162253	0	0.0029495	0.004	0.01176	206.6487191
MDVGAS	Riverside (SC)	2045	MDV	Aggregated	Aggregated	GAS	191212.4565	5876551.774	877329.9185	0.019234121	0	0.133566659	0.000471033	0	0.000684248	0.002000001	0.015750005	0.000512291	0	0.000744183	0.008	0.03675001	265.7930527
MDVDSL	Riverside (SC)	2045	MDV	Aggregated	Aggregated	DSL	6780.221321	212382.9174	31472.0097	0.008974773	0	0	0.000807757	0	0	0.002000001	0.015750005	0.00084428	0	0	0.008	0.03675001	254.965906
MDVELEC	Riverside (SC)	2045	MDV	Aggregated	Aggregated	ELEC	9876.702478	203287.9052	46396.49349	0	0	0	0	0	0	0.002000001	0.015750005	0	0	0	0.008	0.03675001	0
MHGAS	Riverside (SC)	2045	MH	Aggregated	Aggregated	GAS	3010.928726	24934.76398	301.2133098	0.179205415	0	0.297292263	0.00089594	0	0.000286029	0.003000001	0.055860016	0.000974416	0	0.000311083	0.012	0.13034004	1291.716384
MHDSL	Riverside (SC)	2045	MH	Aggregated	Aggregated	DSL	1613.699809	11445.56394	161.3699809	1.86169254	0	0	0.029314159	0	0	0.004000001	0.055860016	0.030639615	0	0	0.01600001	0.13034004	759.7508321
MHDTGAS	Riverside (SC)	2045	MHDT	Aggregated	Aggregated	GAS	2277.981298	78186.47446	45577.8498	0.079633457	0.090193009	0.436361103	0.000910228	0	0.000399641	0.003000001	0.055860016	0.000989955	0	0.000434646	0.012	0.13034004	1273.613483
MHDTDSL	Riverside (SC)	2045	MHDT	Aggregated	Aggregated	DSL	15596.29794	884260.9126	163342.5907	0.861280204	3.290550831	2.162436477	0.00932785	0.000811287	0	0.003000001	0.055860016	0.009749614	0.000847969	0	0.012	0.13034004	682.53591
OBUSGAS	Riverside (SC)	2045	OBUS	Aggregated	Aggregated	GAS	517.1940128	15484.64697	10348.01781	0.366418488	0.065345415	0.381421967	0.000898814	0	0.000274002	0.003000001	0.055860016	0.000977542	0	0.000298002	0.012	0.13034004	1284.408673
OBUSDSL	Riverside (SC)	2045	OBUS	Aggregated	Aggregated	DSL	323.7986058	20625.42276	3087.063048	1.201711465	10.96691832	2.222326664	0.014072546	0.003532072	0	0.003000001	0.055860016	0.014708844	0.003691777	0	0.012	0.13034004	868.1772572
SBUSGAS	Riverside (SC)	2045	SBUS	Aggregated	Aggregated	GAS	441.2354067	12913.02809	1764.941627	0.151344513	0.9265304	0.552234304	0.001453831	0	0.000661043	0.002000001	0.319200087	0.001581174	0	0.000718945	0.008	0.7448002	719.7254244
SBUSDSL	Riverside (SC)	2045	SBUS	Aggregated	Aggregated	DSL	1258.18681	39972.61658	14519.30134	1.834345423	15.53279713	2.137846139	0.003930455	0.003711073	0	0.003000001	0.319200091	0.004108172	0.003878871	0	0.012	0.74480021	879.5542934
UBUSGAS	Riverside (SC)	2045	UBUS	Aggregated	Aggregated	GAS	186.7727158	26296.6283	747.0908631	0.193960702	0	0.438239476	0.001398566	0	0.000589391	0.002386561	0.045038932	0.001521068	0	0.000641017	0.00954624	0.10509084	1097.602888
UBUSDSL	Riverside (SC)	2045	UBUS	Aggregated	Aggregated	DSL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UBUSNG	Riverside (SC)	2045	UBUS	Aggregated	Aggregated	NG	233.1412921	30568.15698	932.5651685	0.443039317	0	0	0.002900574	0	0	0.007354915	0.034520958	0.003031726	0	0	0.02941966	0.0805489	1857.673012

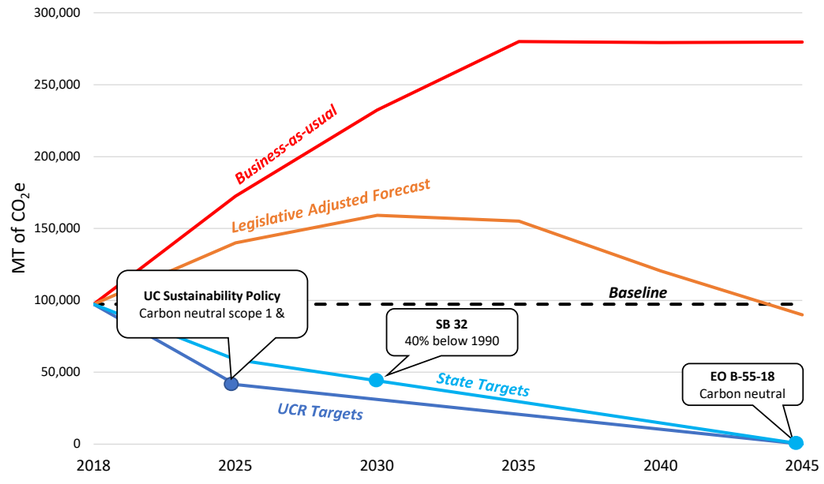
Helper Column	Region	Calendar Year	Vehicle Category	Fuel	Population	VMT	% of Total	Trips	CO2_RUNEX (g/mile)	CH4_RUNEX (g/mile)	N2O_RUNEX (g/mile)	CO2e (g/mile)
	Passenger Vehicles											
LDADSL	Riverside (SC)	2045	LDA	DSL	11293.09269	372770.2538	0.73%	372770.2538	147.8706363	0.000171582	0.0000000	147.8754406
LDT1DSL	Riverside (SC)	2045	LDT1	DSL	13.36988892	423.1438278	0.00%	423.1438278	280.297165	0.000570643	0.0000000	280.313143
LDT2DSL	Riverside (SC)	2045	LDT2	DSL	2922.745156	95055.81694	0.19%	95055.81694	195.8471726	0.000561088	0.0000000	195.8628831
MDVDSL	Riverside (SC)	2045	MDV	DSL	6780.221321	212382.9174	0.41%	212382.9174	254.965906	0.000192139	0.0000000	254.9712859
LDAELEC	Riverside (SC)	2045	LDA	ELEC	59370.65147	1789142.326	3.49%	1789142.326	0	0	0.0000000	0
LDT1ELEC	Riverside (SC)	2045	LDT1	ELEC	3760.389977	110270.4539	0.21%	110270.4539	0	0	0.0000000	0
LDT2ELEC	Riverside (SC)	2045	LDT2	ELEC	13044.94563	270545.539	0.53%	270545.539	0	0	0.0000000	0
MDVELEC	Riverside (SC)	2045	MDV	ELEC	9876.702478	203287.9052	0.40%	203287.9052	0	0	0.0000000	0
MCYGAS	Riverside (SC)	2045	MCY	GAS	37096.05585	188809.8895	0.37%	188809.8895	206.6487191	0.302079877	0.2297145	275.9812907
LDAGAS	Riverside (SC)	2045	LDA	GAS	913041.1954	29936920.33	58.33%	29936920.33	191.3565906	0.000590638	0.0180805	196.1644506
LDT1GAS	Riverside (SC)	2045	LDT1	GAS	97601.24874	3053548.556	5.95%	3053548.556	220.9610655	0.000636149	0.0191131	226.0438396
LDT2GAS	Riverside (SC)	2045	LDT2	GAS	286641.7728	9212604.061	17.95%	9212604.061	218.5158177	0.00081037	0.0240945	224.9235625
MDVGAS	Riverside (SC)	2045	MDV	GAS	191212.4565	5876551.774	11.45%	5876551.774	265.7930527	0.000890812	0.0259785	272.7023088
			Passenger Vehicle Total			***51322312.97***			**197.6803582**	**0.00174425**	**0.019828531**	**202.9837581**
			Passenger Gasoline Total			**48268434.61**	**94.05%**		**206.7270003**	**0.000669691**	**0.02018449**	**212.0946414**
			Passenger Diesel Total			**680632.132**	**1.33%**		**188.0710454**	**0.000232642**	**0**	**188.0775594**
			Passenger Electric Total			**2373246.224**	**4.62%**		**0**	**0**	**0**	**0**
	Light Trucks											
LHDT1DSL	Riverside (SC)	2045	LHDT1	DSL	18251.48509	524334.345	39.69%	524334.345	374.5174276	0.001337104	0.0000000	374.5548665
LHDT2DSL	Riverside (SC)	2045	LHDT2	DSL	7719.58461	209370.591	15.85%	209370.591	412.2775702	0.001469124	0.0000000	412.3187057
LHDT1GAS	Riverside (SC)	2045	LHDT1	GAS	17385.47919	508957.9371	38.53%	508957.9371	625.5191515	0.000878804	0.0094495	628.0478821
LHDT2GAS	Riverside (SC)	2045	LHDT2	GAS	2730.304577	78385.83641	5.93%	78385.83641	717.0096924	0.000868697	0.0089110	719.3954386
			Light-Heavy Truck Total			***1321048.71***			**497.5270672**	**0.001153666**	**0.004169346**	**498.6642465**
			Light-Heavy Truck Gasoline Total			**587343.7735**	**44.46%**		**637.7293134**	**0.000877455**	**0.009377658**	**640.2389616**
			Light-Heavy Truck Diesel Total			**733704.936**	**55.54%**		**385.2926902**	**0.001374777**	**0**	**385.331184**
	Medium Trucks											
MHDTGAS	Riverside (SC)	2045	MHDT	GAS	2277.981298	78186.47446	**8.12%**	78186.47446	1273.613483	0.002048282	0.0295108	1281.491194
MHDTDSL	Riverside (SC)	2045	MHDT	DSL	15596.29794	884260.9126	**91.88%**	884260.9126	682.53591	0.000317026	0.0000000	682.5447867
			Medium-Heavy Truck Total			***962447.3871***			**730.5533624**	**0.000457668**	**0.002397372**	**731.2014807**
	Heavy Trucks											
HHDTGAS	Riverside (SC)	2045	HHDT	GAS	8.877764033	726.7370788	**0.03%**	726.7370788	1485.446747	0.061720867	0.0002283	1487.235438
HHDTDSL	Riverside (SC)	2045	HHDT	DSL	19771.30613	2780447.525	**98.79%**	2780447.525	927.4186026	0.00076067	0.0000000	927.4399014
HHDTNG	Riverside (SC)	2045	HHDT	NG	815.1095049	33231.43013	**1.18%**	33231.43013	2566.574632	4.002252492	0.0000000	2678.637702
			Heavy-Heavy Truck Total			***2814405.692***			**946.9172268**	**0.048024502**	**5.89592E-08**	**948.2619284**
	Urban Buses											
UBUSGAS	Riverside (SC)	2045	UBUS	GAS	186.7727158	26296.6283	**46.24%**	26296.6283	1097.602888	0.003476395	0.0481530	1110.460773
UBUSDSL	Riverside (SC)	2045	UBUS	DSL	0	0	**0.00%**	0	0	0	0.0000000	0
UBUSNG	Riverside (SC)	2045	UBUS	NG	233.1412921	30568.15698	**53.76%**	30568.15698	1857.673012	5.667455554	0.0000000	2016.361768
			Urban Bus Total			***56864.78528***			**1506.185155**	**3.048197363**	**0.022267941**	**1597.435685**

CO2_IDLEX	CO2_STREX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	N2O_RUNEX	N2O_IDLEX	N2O_STREX	ROG_RUNEX	ROG_IDLEX	ROG_STREX	ROG_HOTSOAK	ROG_RUNLOSS	ROG_RESTLOSS	ROG_DIURN	TOG_RUNEX	TOG_IDLEX	TOG_STREX	TOG_HOTSOAK	TOG_RUNLOSS	TOG_RESTLOSS	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	SOx_RUNEX	SOx_IDLEX	SOx_STREX
0	34.83528111	0.061720867	0	0.000228329	0.123177233	0	0.055252844	0.267004019	0	0.001149875	0.050397127	0.246770094	0.01985502	0.030579651	0.389611637	0	0.001258968	0.050397127	0.246770094	0.01985502	0.030579651	26.24131394	0	4.607459274	0.0146997	0	0.000344723
9227.348569	0	0.00076067	0.228045609	0	0.145777289	1.450410697	0	0.016377006	4.909759432	0	0	0	0	0	0.018643974	5.589387376	0	0	0	0	0	0.147698935	72.52175776	0	0.008761791	0.087175414	0
2999.135183	0	4.002252492	1.161674178	0	0.523213029	0.611393327	0	0.063064765	0.017788746	0	0	0	0	0	4.091292322	1.186930381	0	0	0	0	0	14.65425779	22.13215773	0	0	0	0
0	38.83483648	0.000590638	0	0.018080461	0.002869267	0	0.018845405	0.001602793	0	0.063686288	0.036415049	0.151000705	0.080118901	0.088060811	0.002338791	0	0.069728469	0.036415049	0.151000705	0.080118901	0.088060811	0.377576606	0	1.359633695	0.001893629	0	0.000384302
0	0	0.000171582	0	0	0.023243205	0	0	0.00369406	0	0	0	0	0	0	0.004205441	0	0	0	0	0	0	0.122087363	0	0	0.001397909	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	45.17187806	0.000636149	0	0.019113064	0.002993309	0	0.020064754	0.001762888	0	0.068330125	0.047736038	0.188035847	0.130404513	0.138724768	0.002572403	0	0.074812886	0.047736038	0.188035847	0.130404513	0.138724768	0.383639559	0	1.395317786	0.002186589	0	0.000447012
0	0	0.000570643	0	0	0.044058811	0	0	0.012285614	0	0	0	0	0	0	0.013986355	0	0	0	0	0	0	0.129891157	0	0	0.002649816	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	45.7487529	0.00081037	0	0.024094545	0.002847911	0	0.019544155	0.002321473	0	0.088941106	0.04536411	0.180187624	0.164472399	0.177080895	0.003387488	0	0.097379315	0.04536411	0.180187624	0.164472399	0.177080895	0.437499455	0	1.796504087	0.002162391	0	0.000452721
0	0	0.000561088	0	0	0.030784448	0	0	0.012079893	0	0	0	0	0	0	0.013752155	0	0	0	0	0	0	0.125170507	0	0	0.00185146	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
98.53666385	15.48838287	0.000878804	0.085257326	0.009449525	0.007279191	0.002342905	0.027452076	0.002755866	0.273112856	0.040169971	0.055657845	0.271361532	0.021645314	0.033055809	0.004021353	0.398525638	0.043981062	0.055657845	0.271361532	0.021645314	0.033055809	0.104835491	3.781397237	1.348913846	0.006190019	0.0009751	0.00015327
106.3434989	0	0.001337104	0.005098128	0	0.058868924	0.016715717	0	0.028787061	0.109759705	0	0	0	0	0	0.032772155	0.124954127	0	0	0	0	0	0.139414516	0.909745076	0	0.003540537	0.001005328	0
113.265478	17.64162142	0.000868697	0.084963867	0.008911029	0.008226932	0.002310905	0.026755152	0.002715344	0.271027428	0.037001392	0.050967532	0.258995281	0.021023333	0.032200308	0.003962223	0.395482587	0.040511867	0.050967532	0.258995281	0.021023333	0.032200308	0.103920635	3.781397237	1.347080756	0.007095392	0.001120854	0.000174578
174.9347262	0	0.001469124	0.005098128	0	0.064804293	0.027497303	0	0.031629375	0.109759705	0	0	0	0	0	0.036007941	0.124954127	0	0	0	0	0	0.163698061	0.909745076	0	0.003897506	0.001653762	0
0	56.86203728	0.302079877	0	0.229714472	0.06375877	0	0.014946126	2.006395509	0	1.741538379	0.733138072	1.219506506	1.462714931	2.909408865	2.518923543	0	1.897427128	0.733138072	1.219506506	1.462714931	2.909408865	16.61238896	0	8.886861273	0.002044957	0	0.000562696
0	56.11695778	0.000890812	0	0.025978541	0.003020549	0	0.020784034	0.00267655	0	0.100116687	0.073713895	0.206301891	0.284368989	0.303657703	0.003905616	0	0.109615171	0.073713895	0.206301891	0.284368989	0.303657703	0.449810313	0	1.841199127	0.002630238	0	0.000555323
0	0	0.000192139	0	0	0.04007709	0	0	0.004136629	0	0	0	0	0	0	0.004709277	0	0	0	0	0	0	0.134978756	0	0	0.002410345	0	0
0	0	0	0	0	0	0	0	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0.004888026	0	0.00943641	0.028301668	0	0	0	0	0	0
0	20.15640631	0.002843464	0	0.027930642	0.016957189	0	0.035048316	0.007693087	0	0.096950143	0.023311675	0.27507949	0.024482272	0.048701923	0.011225734	0	0.106148203	0.023311675	0.27507949	0.024482272	0.048701923	0.143602581	0	2.110203342	0.012782581	0	0.000199464
0	0	0.001544125	0	0	0.119422251	0	0	0.033244093	0	0	0	0	0	0	0.03784619	0	0	0	0	0	0	0.113697674	0	0	0.007182378	0	0
434.0084953	29.24424235	0.002048282	0.265985346	0.029510789	0.00723709	0.008077443	0.03454269	0.007668649	1.016384149	0.145468856	0.048024716	0.234710138	0.01896282	0.029289918	0.011190074	1.483105364	0.159270087	0.048024716	0.234710138	0.01896282	0.029289918	0.159724361	14.50920751	2.788093048	0.012603438	0.004294866	0.000289395
564.9619111	0	0.000317026	0.00261232	0	0.10728514	0.088804145	0	0.006825482	0.056242527	0	0	0	0	0	0.007770292	0.064027835	0	0	0	0	0	0.054658168	2.375411543	0	0.006448261	0.00533748	0
309.7119787	20.88965708	0.002541351	0.196834495	0.023565578	0.021141558	0.005189474	0.027867254	0.010016835	0.750514416	0.118371475	0.02635551	0.297114529	0.025660549	0.050633112	0.014616542	1.095148875	0.129601866	0.02635551	0.297114529	0.025660549	0.050633112	0.215576179	5.800202883	2.3100276	0.012710265	0.003064851	0.00020672
1963.333971	0	0.000473622	0.035807549	0	0.136465375	0.308608759	0	0.010196944	0.770926711	0	0	0	0	0	0.011608445	0.877641376	0	0	0	0	0	0.085794134	12.50237579	0	0.008202108	0.018548606	0
2181.635572	39.60998418	0.002598988	2.333898538	0.050345655	0.012966338	0.091801005	0.049614582	0.01185076	10.64151815	0.294954699	0.094318124	0.598726776	0.028698728	0.056469778	0.017292601	15.5280783	0.322938268	0.094318124	0.598726776	0.028698728	0.056469778	0.213189531	82.24087757	6.551567893	0.007122267	0.021589053	0.000391973
2717.821369	0	0.000470092	0.012444365	0	0.138253686	0.427203671	0	0.010120943	0.267923769	0	0	0	0	0	0.011521923	0.305010817	0	0	0	0	0	0.125687156	11.31860288	0	0.008309593	0.025676629	0
0	42.69804804	0.003476395	0	0.048153005	0.018349014	0	0.045573525	0.010197108	0	0.181890588	0.025015923	0.099469406	0.007960922	0.013473709	0.014879596	0	0.199147299	0.025015923	0.099469406	0.007960922	0.013473709	0.186732703	0	4.176994247	0.01086167	0	0.000422532
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5.667455554	0	0	0.378698796	0	0	0.080976757	0	0	0	0	0	0	5.784054087	0	0	0	0	0	0	43.77692612	0	0	0	0	0

	1990	2018	2020	2025	2030	2035	2040	2045	2050
Absolute Emissions (MT CO2e)									
Business-as-usual Emissions Forecast	73,559	97,333	114,841	172,425	232,446	279,931	279,266	279,700	278,532
Legislative Adjusted Absolute Emissions Forecast	73,559	97,333	111,021	139,920	159,124	155,029	120,524	89,966	88,524
State Emissions Targets[2]	73,559	97,333	73,559	58,847	44,135	29,424	14,712	0	0
UCR Emissions Targets[3]	73,559	97,333	73,559	41,471	31,104	20,736	10,368	0	0
Emissions Gap		0	37,462	98,448	128,020	134,293	110,156	89,966	88,524

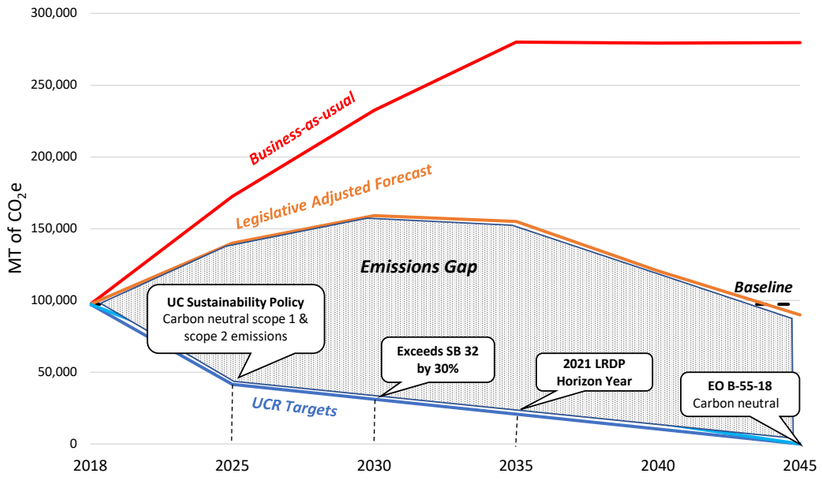
For Graphs:

Emission Pathway (Absolute Emissions)	**1990**	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Baseline	73,559	97,333	97,333	97,333	97,333	97,333	97,333	97,333	97,333
Business-as-usual	73,559	97,333	114,841	172,425	232,446	279,931	279,266	279,700	278,532
Legislative Adjusted Forecast	73,559	97,333	111,021	139,920	159,124	155,029	120,524	89,966	88,524
State Targets	73,559	97,333	73,559	58,847	44,135	29,424	14,712	0	0
UCR Emissions Targets	73,559	97,333	73,559	41,471	31,104	20,736	10,368	0	0



Notes:

1. UCR previously backcast emissions to estimate 1990 levels at 82,167 MT CO2e and are currently working towards meeting that level in 2020. It should be noted that the 1990 inventory has not been audited by a third party and the 1990 levels does not account for growth of the campus. From 1990 to 2018 the campus grew from 9,144 to 23,313 weighted campus users (approximately 155%). 1990 levels have been scaled to incorproated only main campus (approximately 90% of all UCR operational emissions).
2. State emission targets include 40% below 1990 levels by 2030 per SB 32 and carbon neutrality by 204 per Executive Order B-55-18
3. Recommended UCR emission targets incorporate the UC Sustainability Practice Policy goal for carbon neutrality for scope 1 and scope 2 emissions by 2025 and to align with Executive Order B-55-18 to reach total carbon neutrality by 2045. This exceeds the UC Sustainability Practice Policy goal of carbon neutrality of scope 3 emissions by 2050.


300,000
250,000
200,000
150,000
100,000
50,000
0
MT of CO_2e
2018
2025
2030
2035
2040
2045
Business-as-usual
Legislative Adjusted Forecast
Emissions Gap
Baseline
UC Sustainability Policy
Carbon neutral scope 1 & scope 2 emissions
Exceeds SB 32 by 30%
2021 LRDP Horizon Year
EO B-55-18
Carbon neutral
UCR Targets

Appendix G2

GHG Emissions Inventory and Forecast Data Evaluation Memorandum

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March 15, 2021
Rincon Project No: 19-07846

Stephanie Tang, Campus Environmental Planner
University of California at Riverside
1223 University Avenue, Suite 240
Riverside, CA 92507

Submitted via email: stephanie.tang@ucr.edu

Subject: University of California at Riverside 2021 Long Range Development Plan Greenhouse Gas Emissions Inventory and Forecast Data Evaluation Memorandum (Final)

Dear Ms. Tang,

Rincon Consultants, Inc. (Rincon) has completed an evaluation of the greenhouse gas (GHG) emission inventory and forecast data for the University of California at Riverside (UCR) 2021 Long Range Development Plan (LRDP). The UCR 2018 activity data was disaggregated and provided by various UCR departments, including the UC Office of the President (UCOP), Campus Planning, Design & Construction, Transportation and Parking Services (TAPS), Office of Sustainability, and representative utility and service provider data was compiled and provided by the Energy Manager. The GHG inventory and forecast will be developed following standard reporting protocols from The Climate Registry (TCR), California Air Resources Board (CARB), International Council for Local Environmental Initiatives (ICLEI) Local Governments for Sustainability, and American College & University Presidents' Climate Commitment (ACUPCC) adapted from the GHG Protocol: A Corporate Accounting and Reporting Standard developed by the World Business Council for Sustainable Development and the World Resources Institute (WBCSD/WRI).1 These principles serve to guide the measurement and reporting of emissions and include steps to evaluate the relevance, completeness, consistency, transparency, and accuracy of the data used in the inventory and forecast. As part of the data completeness, accuracy, and transparency review, Rincon completed an evaluation to establish a transparent and replicable pathway of emissions reporting and reviewed the data through an internally vetted quality assurance/quality control (QA/QC) process. This memorandum includes an introduction of the Rincon GHG inventory and forecast data validation process; a description of the data evaluation approach; a discussion of GHG inventory data use and methodology; a discussion of GHG forecasts data use and methodology; and a conclusion summary regarding what will serve as the basis for the GHG inventory and forecasts.

[1] World Business Council for Sustainable Development and the World Resources Institute (WBCSD/WRI). 2004. The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. Available: <https://www.wbcsd.org/Programs/Climate-and-Energy/Climate/Resources/A-corporate-reporting-and-accounting-standard-revised-edition>. Accessed April 24, 2020

Introduction

The California 2017 Climate Change Scoping Plan (2017 Scoping Plan), released by CARB in November 2017, outlines the strategy for achieving the State 2030 GHG emission reduction target.[2] Based on the 2017 Scoping Plan, there are nine main economic GHG emissions-generating sectors, including: agriculture, residential and commercial, electric power, high global warming potential (GWP), industrial, recycling and waste, transportation, natural working lands net sink,[3] and the cap-and-trade program.

About 18 percent of the UCR campus is designated as open space that includes approximately 154.8 acres of relatively intact natural habitat identified as Open Space Reserve and43.7 acres associated with the UCR Botanic Gardens. Additional open space, including the interconnected framework of Primary and Secondary open space that are not defined together as a designated land use are incorporated throughout the campus organization and exist within all of the 2021 LRDP defined land use categories.[4] Additionally, land-based research makes up approximately 38 percent (419.3 acres)[5] of UCR existing campus land use which predominantly includes agricultural field research. CARB considered agricultural sources to include off-road farm equipment, irrigation pumps, crop residue burning, emissions from flooded soils, livestock waste, crop residue decomposition, and fertilizer volatilization. The agricultural activities conducted at UCR do not align with the specified emission sources and, therefore, are not considered a significant contributing source to the UCR GHG emission profile. Furthermore, it is not typical under standard GHG reporting protocols for campuses to include agriculture and forestry emissions within the inventory.[11,16] As such, agriculture and forestry source emissions are excluded from the inventory and forecasts and is not discussed in this memorandum. However, the GHG emissions from existing agricultural uses are not anticipated to be affected by implementation of the LRDP. Emissions associated with energy use and on-road transportation for maintenance of these areas is discussed within the respective sections. These land uses devoted to open spaces or land-based research for agriculture would more appropriately be characterized as urban green space and farmland, respectively, within the California Natural and Working Lands Sector.[6] However, GHG sequestration generated from the open space and natural land uses will be excluded from the inventory and forecast due to limited availability of appropriate data.[7] The California Air Resources Board regulates the GHG emissions associated with industrial stationary combustion through the California cap-and-trade program and are excluded from inventory and forecasts for non-industrial facilities. Although UCR is not considered an industrial facility, UCR operates a Central Steam Plant responsible for approximately 95 percent of the natural gas combustion occurring on campus. However, the Central Steam Plant

[2] Per Senate Bill (SB) 32, the State is required to reduce GHG emissions by 40 percent below the 1990 levels by 2030.

[3] Per the 2017 Scoping Plan, work is currently underway to estimate the range of potential sequestration benefits from natural and working land sectors.

[4] As defined in the 2021 LRDP, Primary Open Spaces include significant campus malls, major pedestrian corridors, streetscapes, quads, and plazas, while Secondary Open Spaces are focused on minor pedestrian linkages that foster greater movement throughout campus, as well as smaller, more intimate, courtyard spaces or plazas. They are not defined together as a designated land use but rather exist as a secondary overlay to land use organization.

[5] University of California, Riverside (UCR). (November 2011). 2005 Long Range Development Plan Amendment 2.

[6] CalEPA, California Natural Resources Agency, CDFA, CARB, and California Strategic Growth Council. 2019. January 2019 Draft: California 2030 Natural and Working Lands Climate Change Implementation Plan. Available: <https://ww2.arb.ca.gov/sites/default/files/2019-06/draft-nwl-ip-040419.pdf>. Accessed April 24, 2020.

[7] The reduction in GHG emissions from sequestration may be included in the future to the 2018 baseline inventory and forecast after a comprehensive study based on the natural and working land protocol has been completed.

generates less than 25,000 MT CO2e and, therefore, does not have a compliance obligation under the cap-and-trade regulation;

however, it is reported to CARB under an abbreviated report.[8] Stationary combustion emissions generated from the Central Steam Plant are regulated by the cap-and-trade program and are included in the 2018 inventory under Scope 1 emissions as discussed in detail below.[9]

Several GHG emission accounting protocols have been developed to provide different standardized frameworks that guide businesses, governments, organizations, and other entities in the preparation of emissions inventories depending on the source of emissions and operational control. Standard GHG protocols for organization-focused inventories, such as for UCR, commonly utilize a framework that categorizes emissions by scopes, which account for emissions based on the level of operational control that the organization (in this case, UCR) has over the respective emission sources. Scope 1 emissions are all direct anthropogenic GHG emissions generated from sources that are owned or directly controlled by the reporting organization. Scope 2 refers to GHG emissions that are indirectly generated due to the consumption of purchases or acquired electricity, steam, heating, or cooling. Scope 3 refers to all other indirect emissions not covered under Scope 2 that are associated with sources that are not directly owned or controlled by the reporting organization but are fundamental to the organization's operation. Consistent with standard GHG accounting and reporting protocols, UCR GHG emissions are distributed and discussed by Scope.

The *UC Policy on Sustainable Practices* stipulates that each UC campus must complete regular GHG emissions inventories that comply with the requirements of the *General Reporting Protocol* developed by TCR and *The Second Nature Carbon Commitment's Implementation Guide* developed by the ACUPCC that presents a framework specifically developed for higher education campuses. Based on the requirements of the TCR and ACUPCC GHG reporting protocols, an inventory must include all relevant direct and indirect emissions within the institution's defined reporting boundary and include all six internationally recognized GHGs regulated under the Kyoto Protocol.[10] At a minimum, GHG inventories for a campus must include the following emissions sources: stationary combustion, mobile combustion, process emissions, fugitive emissions, consumption of electricity, employee/student commuting, air travel, and solid waste.[11] These GHG emissions-generating sources will be assessed by scope as part of the UCR GHG Inventory and Forecast. As such, five of the nine economic sectors as defined by the 2017 Scoping Plan (electric power, residential/commercial, high GWP, transportation, and recycling/waste) are discussed in this memorandum. The evaluation in this memorandum includes a review of data received from UCR from the applicable sources by each scope as defined by the TCR and ACUPCC GHG protocols.

[8] CARB. 2019. Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR). Available: <https://ww3.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr-2018-unofficial-2019-4-3.pdf?_ga=2.206872275.1592600053.1594828852-1664137960.1580326972>. Accessed: April 20, 2020

[9] CARB. 2019. CARB Cap and Trade Program. Available: <https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm>. Accessed: April 24, 2020.

[10] The internationally recognized GHGs regulated under the Kyoto Protocol include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and Sulphur hexafluoride (SF_6).

[11] American College & University Presidents' Climate Commitment (ACUPCC). 2012. Implementation Guide Version 2.1. Available: <http://secondnature.org/wp-content/uploads/ACUPCCImplementationGuide_V2.1_.pdf>. Accessed: May 2020.

GHG Inventory and Forecast Data Evaluation Approach

UCR GHG Inventory (2018) Data Validation Process

The current LRDP in use at UCR was originally developed in 2005 with subsequent amendments and bases its assumptions on a projected enrollment of approximately 25,000 students. UCR is rapidly approaching that milestone with approximately 24,000 students enrolled as of Fall 2018, the time at which the baseline inventory will represent.[12] As a result, UCR is currently preparing a 2021 LRDP and LRDP EIR to submit to the Board of UC Regents for anticipated certification by Fall 2021 that will identify the physical development needed to accommodate an increase to approximately 35,000 students plus supporting faculty and staff through 2035. Concurrently, the goals outlined in both the UCOP *Sustainability Practices Policy* and State climate change regulations evolved significantly between 2010 and 2020, creating an opportunity for the 2021 LRDP to define the roadmap for how UCR will meet those new goals. The overarching goal of the 2021 LRDP in terms of GHG emissions is to identify and establish an appropriate GHG emissions baseline inventory representative of the 2021 LRDP that will allow for future GHG emissions forecasting and GHG emissions reduction plan (GHGRP) development.

Since 2013, UCR has tracked its emissions internally (as stipulated by the *UC Policy on Sustainable Practices*) and reported them through the Second Nature Carbon Commitment on-line reporting tool at least biennially through TCR. However, the data reported is for the entire UCR campus including the main campus as defined in the 2021 LRDP as well as satellite facilities under UCR operational control. Therefore, consistent with the scope of the LRDP, Rincon will utilize the source data used for only the main campus GHG emission tracking to develop an inventory that encompasses the 2021 LRDP area for the 2018 calendar year using calculation-based methods and following standard GHG reporting protocol methodologies as outlined below.

[12] There were 20,581 undergraduate students during the 2019 – 2020 school year. (US News. 2020. Available: <https://www.usnews.com/best-colleges/university-of-california-riverside-1316>. Accessed May 1, 2020

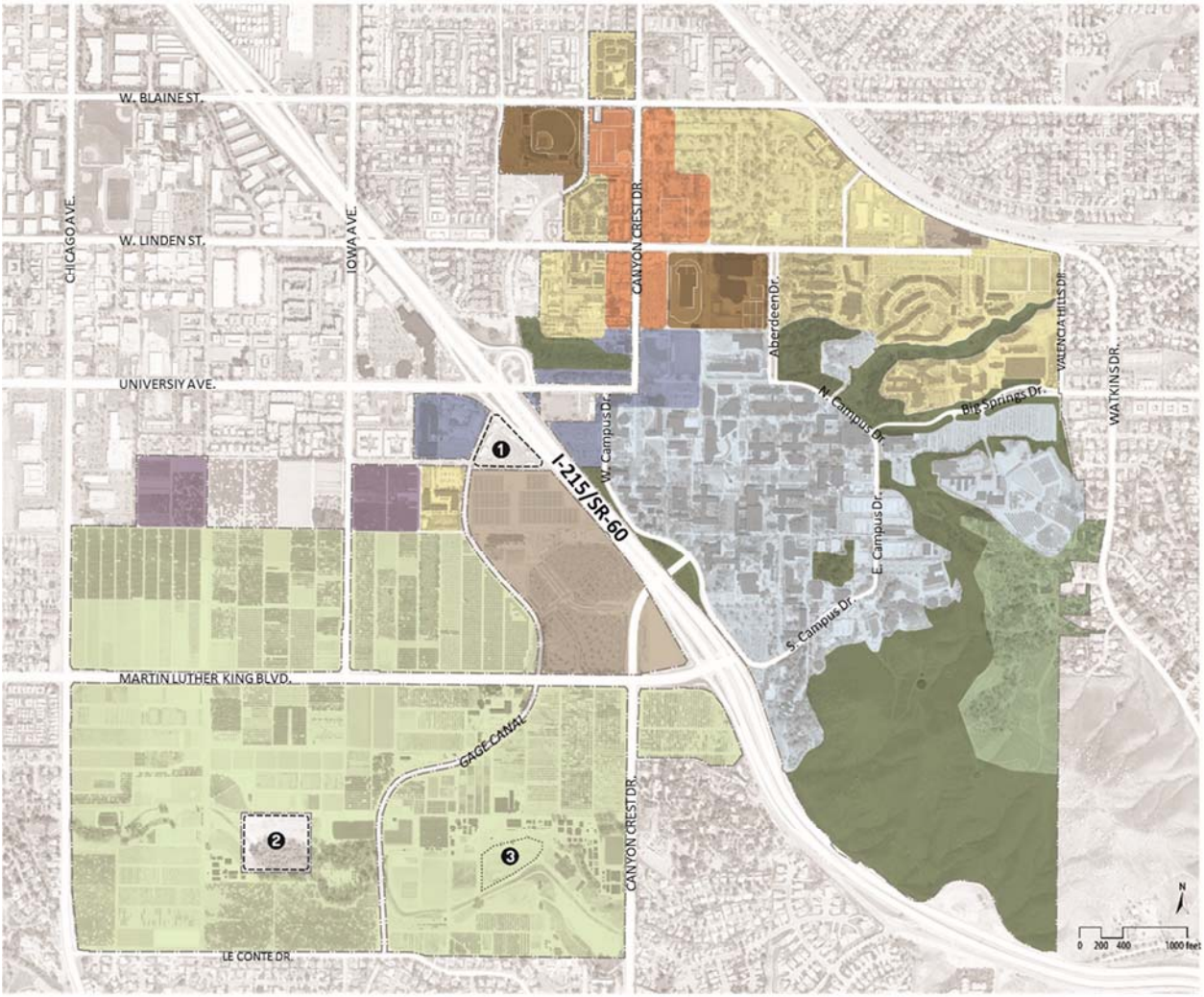
GHG Inventory (2018) Data Review

As part of the data evaluation, Rincon used the UCR Draft 2021 LRDP as well as communicated with UCR staff to understand characteristics that would influence the UCR GHG emissions inventory. The following discussion provides an overview of the data that was provided by UCR and reviewed by Rincon, including an explanation of the sources from which the data was acquired, what the data includes, and how the data will be used in development of the inventory. As part of the data evaluation, Rincon also reviewed the data for completeness and accuracy, and the data is presented within this memorandum to provide transparency and a replicable pathway for future UCR emissions reporting completed as part of the implementation monitoring of the GHGRP.

GHG Inventory (2018) Geographic and Operational Boundaries

To be consistent with standardized GHG reporting protocols such as those prepared by ICLEI, TCR, and ACUPCC, a clear delineation of the geographic and operational boundaries used to account for emissions in an inventory must be established. Therefore, the boundaries for the baseline inventory and forecasting has been limited to the geographic and operational boundary of the 2021 LRDP. Similar to the 2005 LRDP, the 2021 LRDP encompasses the approximate 1,108 contiguous acres constituting the UCR main campus, which is bisected by the I-215/SR 60 into two distinct areas commonly referred to as East Campus and West Campus. Figure 1 depicts the UCR main campus (i.e., the designated 2021 LRDP area) obtained from the UCR 2021 Draft LRDP. The baseline GHG inventory and future GHG emissions forecasts for the 2021 LRDP will include emissions from all facilities and sources within these boundaries for which UCR has operational control over.

Figure 1 2021 UCR LRDP Land Use Map



LEGEND: LAND USE DIAGRAM

1. Caltrans Yard, not in LRDP planning scope
2. City of Riverside property, not in LRDP planning scope
3. Development of this approximately 3.25-acre site shall be prohibited from developing uses per a Covenant to Restrict Use of Property entered into between the Department of Toxic Substances Control and The Regents of the University of California, in which a deed restriction was filed on July 26, 2006

- ACADEMICS & RESEARCH
- AGRICULTURAL/CAMPUS RESEARCH
- LAND-BASED RESEARCH
- CAMPUS SUPPORT
- OPEN SPACE RESERVE
- UCR BOTANIC GARDENS
- RECREATION & ATHLETICS
- STUDENT NEIGHBORHOOD
- CANYON CREST GATEWAY
- UNIVERSITY AVENUE GATEWAY
- NON-UCR LAND OF INTEREST

GHG Inventory (2018) Data and Methodology

Inventory Year

The State of California uses 1990 as a reference year to remain consistent with Assembly Bill (AB) 32 and Senate Bill (SB) 32, which codified the State GHG emissions targets by directing CARB to reduce Statewide emissions to 1990 levels by 2020. However, organizations throughout California typically elect to use years later than 1990 as baseline years because of the increased reliability of recordkeeping from those years and the large amount of growth that has occurred since 1990. Additionally, the UCR 2005 LRDP projected out to the 2015-2016 academic year. The 2005 LRDP Amendment extended the horizon year out to 2020-2021 academic year. The year 2018 was selected as the baseline year for the UCR Inventory, as it is the most recent and complete data set available and the most accurate. As such, data from 2018 has the level of detail necessary to validate the data and disaggregate the data for just the 2021 LRDP boundary. It is important to note that in 2016 Statewide GHG emissions fell below 1990 levels, generally achieving the target of AB 32.[13] The data from this inventory will be used to develop a forecast for year 2035, the 2021 LRDP horizon year. A forecast for 2030 and 2045, which is consistent with the State target years established in Senate Bill (SB) 32 and Executive Order (EO) B-55-18 will also be developed using this inventory data in a subsequent document.

Inventory Building Space and Demographic Data

The 2018 baseline inventory includes a total campus population of 28,661 which includes 23,922 students and 4,739 faculty and staff members.[14] Campus space in 2018 totaled approximately 4,803,500 assignable square feet (asf) or approximately 7,205,250 gross square footage (gsf).[15]

Scope 1 Emissions

Scope 1 emissions are defined as direct GHG emissions generated from sources within UCR operations that it owns and/or controls. This includes stationary combustion of fuels in any stationary equipment to produce electricity, steam, heat or power using equipment in a fixed location; mobile combustion of fuels in fleet transportation sources and emissions from off-road equipment such as those in construction, agriculture, and forestry; process emissions other than fuel combustion from physical or chemical processing; and 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. Under Scope 1, UCR reports all campus emissions from natural gas and diesel stationary combustion at its facilities and buildings, mobile combustion emissions from the UCR mobile fleet, and vanpool, as well as usage of refrigerants in HVAC and ventilation systems. UCR does not have operational control of any physical or chemical processes other than fuel combustion; therefore, emissions associated with physical or chemical processes will not be included in the inventory. Scope 1 emissions reported by UCR annually

[13] CARB. 2018. Climate pollutants fall below 1990 levels for first time. Available: <https://ww2.arb.ca.gov/news/climate-pollutants-fall-below-1990-levels-first-time>. Accessed April 24, 2020

[14] Campus population as Full-time equivalents (FTE) was approximately 23,313.3 in 2018 based on UCOP approximation provided by UCR Campus Planning Department.

[15] Per UCR direction, the standard space planning assumption of 1.5 is used to convert assignable square feet (asf) to gross square feet (gsf).

were calculated using natural gas utility data from service providers (stationary combustion), inventoried fuel usage (mobile combustion), and refrigerant usage (fugitive emissions) tracked by various UCR Departments. Rincon completed a review of the calculations and found them to be consistent with the methodologies and principals outlined in the General Reporting Protocol (GRP).[16] Emissions are estimated by collecting activity data such as therms of MMBtu of natural gas used in facilities and buildings; gallons of diesel used for portable generators, heaters, etc.; gallons of fuel used by the UCR vehicle fleet, and pounds (lbs) of refrigerants used in facilities and buildings. UCR disaggregated source data in order to provide activity data for solely the main campus included in the 2021 LRDP area. Table 1provides a summary of UCR Scope 1 activity data for the 2021 LRDP GHG inventory.

Table 1 Scope 1 Inventory Data Review

Sector/Emission Source	*Data Type Received*	*Activity*	*Units*
Stationary Combustion			
Natural Gas (Shell)	Annual utility Data	346,611	MMBtu
Diesel	Fuel use summary spreadsheet	8,003	Gallons
Mobile Combustion			
Vehicle Fleet	Fleet vehicle, fuel and mileage data	146,820	Gallons
Process & Fugitive Emissions			
Refrigerants used for Heating, Ventilation, and Air Conditioning (HVAC)	Refrigerants usage summary	433.25	lbs

All presented data was provided by UCR and is based on 2018 calendar year.

Stationary Fuel Combustion

Natural Gas Use in UCR Facilities and Buildings

As discussed during the GHG inventory and forecast data scoping meeting with UCR and Rincon on January 31, 2020, the Central Steam Plant makes up approximately 95 percent of campus natural gas usage. Natural gas is transported to the UCR main campus by Southern California Gas Company (SCG) and is procured through Shell. The UCR Energy Manager compiled monthly invoices for all accounts associated with the main campus and provided the natural gas data in the form of a single workbook that presented monthly natural gas consumption by utility provider. For purposes of the 2018 GHG inventory, utility data will be assessed by usage on a calendar year basis. GHG emissions associated with UCR natural gas consumption will be estimated using the recommended method outlined in TCR GRP v3.0 for *Calculating Emissions from Stationary Combustion Using Duel Use Data*. TCR GRPv3.0 methodology is based on default emission factors obtained from the most recently updated TCR default emission factor list (TCR 2019).[17]

[16] TCR. 2019. General Reporting Protocol Version 3.0.
[17] TCR. 2019. 2019 Default Emission Factors. Available: <https://www.theclimateregistry.org/wp-content/uploads/2019/05/The-Climate-Registry-2019-Default-Emission-Factor-Document.pdf>. Accessed May 2020.

Diesel Use in UCR Facilities and Buildings

In addition to natural gas, UCR used diesel fuel to power portable generators and heaters during the 2018 data year. Annual diesel and propane usage data for the UCR main campus was provided to Rincon by the UCR Office of Sustainability in a fuel use summary spreadsheet based on a summary of invoices provided to UCR during the calendar data year. In past years, propane was used as well, however, no propane was used in 2018 and therefore no propane emissions will be included in the inventory. GHG emissions associated with UCR operational diesel consumption will be estimated using the recommended method outlined in TCR GRPv3.0 for *Calculating Emissions from Stationary Combustion Using Duel Use Data* based on default emission factors obtained the most recently updated TCR default emission factor list.[17]

Mobile Fuel Combustion

Fuel Use by UCR Fleet and Department Vehicles

UCR uses bi-fuel, compressed natural gas (CNG), gasoline, diesel, electric, flex fuel, and hybrid-powered fleet vehicles/equipment and fuel is purchased from a variety of suppliers. UCR provided Rincon with fuel use data and a detailed vehicle list for UCR-owned fleet for the 2018 calendar year. The provided fleet list and fleet fuel usage and associated GHG emission generation is tracked for the entire UCR campus by the Office of Sustainability. The UCR Sustainability Officer confirmed that while it is not possible to disaggregate the fleet fuel usage specific to just the LRDP boundary versus other satellite UCR facilities, the vast majority of all fleet vehicle fuel usage is associated with the main campus.[18] Therefore, the presented fleet vehicle fuel usage is conservatively assumed representative of the main campus fleet fuel usage. Since specific fuel volumes and fleet mix were provided, emissions will be calculated using TCR GRPv3.0 Method A: *Actual Fuel Use*, with vehicle specific emission factors obtained from the CARB EMission FACtors (EMFAC2017) model and equipment emission factors from USEPA *Emission Factors for Greenhouse Gas Inventories*.[19,20]

Process and Fugitive Emissions

Refrigerants Use in UCR Facilities and Buildings

UCR uses refrigerants in the Heating, Ventilation, and Air Conditioning (HVAC) equipment. Refrigerant data is provided in a "Usage Summary Report" document that totals usage by refrigerant type by the 2018 calendar year. Refrigerant data was disaggregated by the Sustainability Officer to provide just the refrigerant usage associated with the main campus. The Usage Summary Report 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. Therefore, 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. This is consistent with the TCR GRPv3.0 Method A: *Simplified Mass Balance*. Emissions will be calculated based on annual usage of refrigerant and emission factors/global warming potential (GWP) from USEPA *Emission Factors for Greenhouse Gas Inventories*.[19]

[18] Confirmation was made verbally during the April 24, 2020 call with the UCR team during the review of provided data.
[19] USEPA. 2018. Emission Factors for Greenhouse Gas Inventories. Available: <https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf>. Accessed May 2020.
[20] CARB. 2018. EMFAC2017 Volume III – Technical Documentation. Available: <https://www.arb.ca.gov/emfac/>. Accessed May 2020.

Scope 2 Emissions

Scope 2 GHG emissions are those generated at power plants when generating electricity. Scope 2 emissions reported by UCR annually were calculated using utility data from electricity service providers. Electricity usage at UCR is complex as it is acquired from a variety of sources. Specifically, UCR electricity is provided by the Imperial Irrigation District (IID), Riverside Public Utility (RPU), Southern California Edison (SCE), and SunPower. However, UCR disaggregated utility data shows that main campus electricity is only provided by RPU. Additionally, UCR reports the amount of electricity generated from installed solar photovoltaic systems on main campus. Main campus solar power generation are from SunPower Lot 30, 32, and Solar Farm. Rincon completed a review of the calculations and found them to be consistent with methodologies and principals outlined in the GRP.[21] Table 2 provides a summary of the Scope 2 emission sources, the data received, activity usage, and reported units including electricity usage and solar power generation.

Table 2 Scope 2 Inventory Data Review

Sector/Emission Source	*Data Type Received*	*Activity*	*Units*
Electricity			
Electricity Usage - Riverside Public Utility (RPU)	Summary spreadsheet of usage summarized by utility provider (IID, RPU, and SCE) *	107,088,200	kWh
Solar Electricity Production – SunPower	Summary spreadsheet of production summarized by utility provider (SunEdison)	11,872,475	kWh

All presented data was provided by UCR and is based on 2018 calendar year.

Source: Data compiled by Rincon in May 2020.

Note: *Only the RPU data was primarily used as they are the primary electrical service provider for main campus.

Electricity Consumption

UCR Building and Facility Electricity Use

Based on UCR disaggregated utility data, RPU is the only electricity provider for main campus. To calculate GHG emissions associated with electricity generation by RPU, the sum-total of kilowatt hours (kWh) derived from a specific source is totaled and multiplied by the corresponding GHG emissions factors. GHG emissions associated with UCR electricity consumption will be estimated using TCR GRPv3.0 Method A *Known Electricity Use*, based on monthly electric bills or electric meter records providing the number of kilowatt-hours of electricity consumed. RPU is an importer of electricity. Therefore, the appropriate eGrid factors will be applied to the baseline-year inventory and adjusted based on the 2018 Power Content label.

[21] TCR. 2019. General Reporting Protocol Version 3.0.

Electricity Generation

SunPower Solar PV installations are connected to UCR distribution circuits at the substation and directly feed into the campus. As such, no GHG emissions are associated with the on-site UCR solar generation of electricity. As such, this information related to electricity production by Sunpower will be reported solely for informational purposes and used during forecasting and future GHGRP implementation tracking.

Scope 3 Emissions

Scope 3 emissions are other emissions that are generated from the activities of the institution but occur from sources not fully controlled by the institution. Scope 3 emissions reported by UCR annually have included emissions generated from faculty air travel and mobile emissions generated from staff and student employees commute. UCR tracks faculty air travel through invoices and the miles of air travel incurred from origin to destination on a calendar basis. Staff and student employee commute emissions is based on the estimated VMT and associated fuel consumption by employee commuters from a commuter survey administered by UCR staff. Emissions were calculated based on the estimated gallons of gasoline consumed and emission factors attained from the CCAR Protocol.

In addition to faculty air travel and staff and student employee commuting, emissions associated with the RTA buses that travel to and from the main UCR Campus and waste generation will also be included in the baseline inventory. Because construction associated with the 2021 LRDP is a future program, it is not representative of past construction projects and therefore would not be appropriate to apply such emissions to previous years. Emissions associated with all on-site VMT will be calculated based on the modeled UCR VMT provided by Fehr & Peers (F&P). UCR provided faculty air travel miles by calendar year, commuter survey data by fiscal year, RTA ridership data by fiscal year, and waste generation by fiscal year. Due to the data sources and means of compiling the Scope 3 source data, disaggregation of UCR main campus data from total UCR campus data was not possible for faculty air travel, employee commute, and waste. However, UCR staff indicated that a majority of the listed Scope 3 activities would be associated with the main campus. Therefore, for the purposes of this inventory it is conservatively assumed that the activity data and associated emissions sources for the Scope 3 data is representative of main campus. Scope 3 data collection and emissions calculations will follow the methodologies outlined in the TCR GRPV3.0, ICLEI Local Government Operations Protocol, and the ACUPCC *Second Nature Carbon Commitment's Implementation Guide*. Table 3 provides a summary of the Scope 3 emission sources to be included in the 2018 inventory.

Table 3 Scope 3 Inventory Data Review

Sector/Emission Source	*Data Type Received*	*Activity*	*Units*
BusinessTravel[1]			
Faculty/Staff Air Travel	Spreadsheet summarizing faculty airline travel	8,273,344	Passenger Miles
On-Site Transportation			
Non-transit Vehicle Transportation[1]	F&P Vehicle Miles Traveled spreadsheet[4]	259,244	Daily VMT
Employee Commute Subset[2,3]	Results from employee commuter survey	(38,852,897)	VMT
Transit Vehicle Transportation (RTA)[1]	RTA UPASS –ridership data spreadsheet	554,396	# of rides
Waste Generation[2]			
Waste sent to landfill, recycling center, and composting facility[5]	Waste summary spreadsheet	4,246.5; 66% 1,008.7; 96%	MSW tons generated; MSW diversion rate C&D tons generated; C&D diversion rate

1. Data is presented on a calendar year basis based on format of data provided.
2. Data is presented on a fiscal year basis based on format of data provided.
3. Employee/staff commuter data is a subset of overall UCR on-site transportation but is presented and discussed separately for the purpose of future GHG reduction measure development focused on UCR employee commuters.
4. Daily VMT provided by F&P is adjusted according to the Origin-Destination (O-D) Method as described in the following section.
5. Fiscal year 2017/2018 and 2018/2019 was averaged to provide an estimate of waste in 2018 calendar year. Provided waste data included Municipal Solid Waste (MSW) and Construction & Demolition (C&D).

All presented data was provided by UCR or F&P and is reflective of the 2018 calendar year. Data provided on a fiscal year basis may be further processed to be representative of a calendar year.

Source: Data compiled by Rincon in May 2020.

Business Travel

UCR Faculty/Staff Air Travel

UCR requires various faculty air travel trips to be made throughout the calendar year, which are summarized in a spreadsheet that provides invoice information, details on flight origin and destination, date the flights were taken, airline, and miles traveled. The total mileage traveled during the data year will be used to calculate the total emissions, based on the Federal Aviation Administration (FAA) aviation energy intensity factors per passenger mile and emission factors obtained from average USEPA *Emission Factors for Greenhouse Gas Inventories*. [19,22]

[22] Federal Aviation Administration (FAA) Office of Environment and Energy. 2005. Aviation & Emissions: A Primer. Available: <www.faa.gov/regulations_policies/policy_guidance/envir_policy/ media/AEPRIMER.pdf>. Accessed May 2020.

On-site Transportation

Non-Transit Vehicle Transportation

All Non-Transit UCR Vehicle Travel

Beyond the UCR fleet, transportation emissions on-site are generated by students, on-campus residents, faculty/staff employees, and campus visitors through on-road transportation. On-road transportation-related to UCR community vehicle miles traveled (VMT) data for calendar year 2018 and 2035 will be calculated by F&P based on outputs of the current version of the Riverside County Traffic Analysis (RivTAM) travel demand model, a regional version consistent with the SCAG model.[23] Traffic will be interpolated based on the modeled years. The transportation analysis for the LRDP will focus on East and West Campus using campus population data provided by UCR for the 2018/2019 academic year. The VMT data used for the inventory will be based on the RivTAM activity-based model and the Origin-Destination (O-D) method, the preferred method of ICLEI and TCR. The O-D methodology is consistent with the Regional Targets Advisory Committee (RTAC) pursuant to Senate Bill 375. The O-D method includes all trips occurring within UCR LRDP boundaries and half of any trips that either originate or terminate within the UCR LRDP boundaries and excludes VMT from through trips (i.e. not originating or terminating within UCR LRDP boundaries). Like the Trip Based SCAG model, RivTAM utilizes socio-economic data (i.e. population, employment, households, workers, school enrollment, etc.), transportation analysis zones (TAZ), the highway and transit network to calculate VMT for UCR. VMT data is based on the assumption that UCR student population and faculty/staff population was 23,922 and 4,739, respectively, in the 2018/2019 academic year and will be approximately 35,000 and 7,545, respectively, in the LRDP horizon year of 2035/2036 academic year.

Emissions due to passenger vehicle operation will be calculated using the recommended ICELI CP *Method TR.1.A*. Equations *TR.1.B.2* and *TR.1.B.3* will be used to convert provided VMT data into emissions data and regional emission factors from the most recent CARB EMFAC2017 model will be used. EMFAC2017 VMT-based emission rates are based on the vehicle class, model years, speed, and fuel type.[20] A fleet-wide emission factor will be calculated using the mix of vehicle class specific to UCR determined via the Trip Base RivTAM model. Emissions from freight and service trucks (i.e. medium- and heavy-duty trucks) will be calculated using ICELI CP *Method TR.2.C*, which is similar to assignment of passenger emissions except that emission factors for heavy-duty vehicles may be obtained from the EPA State Inventory Tool as recommended by the ICELI protocol.

UCR Employee Commute Subset

Emissions from UCR employee commuting (e.g., faculty, staff, and student employees) are a subset of the overall UCR on-road transportation and transit emissions associated with UCR on-site traffic as described in detail above. As such, trips associated with employee commuting have already been captured through on-road transportation VMT and transit ridership reported in Table 3. However, for future measures development emissions generated specifically from UCR employee commuting will be quantified based on commuter survey results and therefore, are presented separately in Table 3.

[23] Fehr & Peers. 2020. Draft UC Riverside 2021 Long Range Development Plan Transportation Impact Study. Prepared August 2020.

To gather data related to employee and staff commute, Rincon was provided with the results of a survey completed in support of the South Coast Air Quality Management District (SCAQMD) Employee Commute Reduction Program (ECRP). The survey is sent out to staff annually during the month of April and the results are compiled by the Director of Transportation and Parking Services (TAPS). Likewise, the commute data for students was also determined through the results of a SCAQMD student survey and represents staff and student employee commuting for the fiscal year of 2018/2019. The survey results are summarized in an excel spreadsheet provided to Rincon by UCR, which includes the number of employees, staff, and student employees, the total vehicle miles traveled, and the estimated gallons of fuel consumed for the fiscal year of 2018/2019. For the purposes of this inventory it is assumed that the fiscal year survey data is representative of the 2018 calendar year. Emissions will be quantified based on the estimated VMT traveled as reported in the commuter survey data and an estimated fleet vehicle mix for passenger vehicles based on the EMFAC2017 model for the region in year 2018.[20] Emissions factors derived from the EMFAC2017 model will be used to estimate GHG emissions from personal vehicle commutes. [24]

Transit Vehicle Transportation

UCR Staff/Student Transit Travel

The Riverside Transit Agency (RTA) is the public transit agency that serves the UCR main campus via six bus routes. UCR provided ridership data for the RTA bus routes that are subsidized through the UPASS bus subsidy program on an annual basis since Fall 2006. Ridership data for the 2018 calendar year is compiled in Table 3. Emissions from community use of the transit system including public buses (i.e. RTA), will be estimated using Method TR.4 and using fuel use or mileage data available from the National Transit Database. ICELI recommends that for Methods TR.4, the attribution method (TR.4D) should be used such that emissions associated with these transit services are based solely on what occurs within the geographic boundary of the UCR main campus (i.e., miles traveled within the UCR 2021 LRDP boundary). It should be noted that the attribution methodology is limited in that there is not an absolute way to link the use of the transit system within UCR campus limits to the people of (i.e. the transit emissions will be calculated the same regardless of whether all of the UCR community uses the transit system or no one does). Therefore, data provided by UCR regarding ridership through the UPASS program will be used to further refine the attribution of RTA emissions to the UCR community.

Waste Generation

UCR Faculty/Staff Waste Generation

Waste generation at UCR is based on UCR main campus activities (e.g., dining hall waste, construction, and demolition), staff, on-campus residents, and campus visitors. Because the campus does not operate a landfill, GHG emissions attributed to solid waste from UCR are associated with the emissions generated during waste transport from UCR main campus to a landfill and the methane emissions generated as waste decomposes at a landfill. UCR provided 2018/2019 fiscal year data including tonnage generated and diverted, type of waste generated from the Zero Waste Working Group as well as the location of waste

[24] California Air Resources Board (CARB). 2018. EMFAC2017 Volume III – Technical Documentation. Available: <https://www.arb.ca.gov/emfac/>. (Accessed May 2020.)

pickup on campus and the hauler information from UCR staff. Because the data was provided by fiscal year, 2018 calendar year data will be estimated using a weighted average of data from the 2017/2018 fiscal year and 2018/2019 fiscal year. Additional waste disposal and landfill information will be obtained based on the disposal facilities, hauler information and information available through CalRecyle. Details for calculations regarding the total emissions and land fill gas capture rates for each waste destination facility were obtained from the EPA Landfill Methane Outreach Program and GHGRP FLIGHT database. The recommended ICLEI Methods SW.4, SW.5, SW.6, and SW.7 to calculate emissions associated with methane emissions from waste sent to landfills, landfilling process emissions, collection and transport emissions and waste sent to combustion facilities, respectively, will be used. Because UCR does not have operation control over a landfill, waste-in-place emissions are excluded from the inventory.

GHG Forecasts (2030, 2035, 2045) Data and Methodology

Forecast Years

The GHG baseline inventory provides accurate reference points for emissions levels in past years for the UCR main campus as defined above. Because annual emissions of the UCR main campus as defined in the LRDP will change over time due to increased student demand and enrollment, increased employment, and operational changes to accommodate the enrollment increase, an emissions forecast which accounts for these changes is needed to estimate the level of GHG reductions required to achieve future State targets. Forecasting future GHG emissions also allows for a comparison between the forecasted GHG emissions and the reduction goal. The gap between these two points is what will ultimately allow for accurate climate action planning via development of GHG emissions reduction measures that assist UCR in achieving its GHG reduction goals.

The future GHG emissions forecast will model the maximum projected build out for the Land Use Designations as defined by the 2021 LRDP which includes the area associated with the interim projects between 2018 and 2020, while also accounting for planned GHG reductions from State-level policies and UC sustainability policies. To be consistent with the CEQA and CEQA Guidelines requirements for a GHG reduction strategy and to align with State targets required by SB 32 and EO B-55-18 as well as account for the LRDP horizon year of 2035, the GHG forecast will be provided for calendar years 2030, 2035, and 2045. The 2030 forecast, specifically, will account for the construction and operational emissions associated with the interim projects between 2018 and 2020.

UCR 2021 LRDP Building Space and Population Projections

GHG forecasted emissions will be based on campus energy-use trends, the anticipated impact of LRDP developments, the anticipated impact of existing energy efficiency and GHG reduction programs, and campus growth assumptions consistent with the LRDP. Table 4 and
Table 5 provide a summary of the LRDP building and population growth assumptions used in the GHG emissions forecasting obtained from UCR. Per the 2021 LRDP, growth modeling is based on the LRDP building growth current student population, historic student growth trends for UC Riverside, delivery time required to build new facilities, and infrastructure needs. Projected size of program space type is presented in assignable square feet (asf),

or the area within the interior walls of a room that can be assigned to a program.[25] However, emissions generated from energy consumption and building construction are dependent on total building space and materials necessary to construct a building, not just the area within interior walls of a building. Therefore, for the purposes of forecasting operation and construction, assignable square feet (asf) will be converted to gross square footage (gsf) using the standard space planning assumption ratio of 1.5 per UCR direction.

The forecast will include a Business-As-Usual (BAU) scenario, where forecasted emissions are estimated assuming no change in current consumption trends absent of any new regulations that would reduce emissions. An adjusted scenario that takes into account foreseeable regulatory changes affecting GHG emissions at the federal, State, and local level that include SB 100 (Renewables Portfolio Standard), Title 24 Building Energy Efficiency Standards, SB X7-7, SB 1425, Low Carbon Fuel Standard (LCFS), Pavley Clean Car Standards, Advanced Clean Cars Program, and other applicable regulations will also be developed. A further Adjusted scenario including the prescribed *UC Policy on Sustainable Practices* in addition to applicable State and local regulations will also be developed to show the potential emission reductions associated with implementation of the UC Policies.

Table 4 UCR 2021 LRDP Building Space Program Projections

Land Use	*Baseline (Academic year 2018/2019)*	*2021 LRDP (Academic year 2035/2036)*	*Net 2021 LRDP Increase from Baseline*
Academics & Research			
Classroom and Services	113,282	290,252	176,970
Teaching Lab and Service	102,729	165,800	63,071
Open Lab and Service	116,743	129,500	12,757
Research Lab and Service	887,529	1,115,300	178,090
Academic Support			
Offices and Services	996,834	1,583,415	586,581
Library & Collaborative Learning Space	337,551	514,789	177,238
Assembly and Exhibit	54,988	117,000	62,012
Other Department Space	69,602	140,000	70,398
Student Life			
Residential	1,525,647	3,643,620	2,117,973
Residential Dining	55,802	94,527	38,725
Student Health	14,117	24,500	10,383
Student Union	97,122	187,422	90,300
Other Campus Space			
Corporation Yard	248,279	248,279	0

Values are expressed in assignable square feet (asf).
Source: Draft 2021 LRDP Program Model, September 18, 2019

[25] Assignable square feet (asf) is defined as the area measured within the interior walls of a room that can be assigned to a program and does not include circulation, mechanical, restrooms, or building service spaces.

Table 5 UCR 2021 LRDP Campus Population Projections

Land Use	*Baseline (2018/2019)*	*2021 LRDP (2035/2036)*	*Net 2021 LRDP Increase from Baseline*
Students			
Undergraduates	20,581	28,000	7,419
Graduates	3,341	7,000	3,659
Faculty and Staff			
Ladder Rank Faculty	841	1,285	444
Other Instructional Faculty	332	486	154
Non-Teaching Academic Appointment	529	774	245
Non-Academic Staff	3,037	5,000	1,963
Student Workers			
Non-Academic Student Staff	2,068	3,026	958
Graduate Student Appointments	1,928	2,821	893

Source: Draft 2021 LRDP Program Model

UCR 2021 LRDP Emissions

Operation-related GHG emissions from building electricity and fuel use; utility electricity generation/transmission; vehicle fuel use by UCR fleet vehicles/employee and student commute; refrigerant process/storage; waste generation, as well as construction-related GHG emission from building demolition/construction materials and construction vehicle/equipment fuel use will be forecasted using various models and plan-specific data and reports provided by UCR. Modeling will be based on LRDP-specific information when available (e.g., land use types, traffic modeling, building size). The California Emissions Estimator Model (CalEEMod) Version 2016.3.2 developed by the State of California to provide a uniform platform for quantification of GHG emissions associated with the construction and operation from land use projects will be used to forecast construction/demolition emissions anticipated from the LRDP and future operational emissions.

Scope 1 Emissions

Stationary Fuel Combustion

Stationary source fuel use emissions other than natural gas usage in buildings is associated with portable generators and heaters. Forecasted stationary source emissions will be based on LRDP anticipated building growth in gross square feet (gsf). No new UC buildings or major renovations approved after June 2019, except in special circumstances, will use on-site fossil fuel combustion, such as natural gas, for space and water heating.

Mobile Fuel Combustion

Mobile emissions generated from the UCR fleet will be forecasted based on the 2021 LRDP-anticipated growth of student employees and staff population and emission factors from EMFAC2017 model.

Fuel Process and Storage

Refrigerant process and storage at UCR is associated with the usage in chillers, heaters, ventilation and HVAC systems. Therefore, forecasted refrigerants usage will be forecasted based on anticipated LRDP building growth in gross square feet (gsf).

Scope 2 Emissions

Electricity Consumption

Emissions from energy use include electricity and natural gas use. UCR also generates electricity via solar photovoltaic systems. Forecasted building energy use will be estimated using CalEEMod and UCR specific energy data and energy use intensity factors (EUIs). Energy data and EUI calculations for existing buildings on the main campus provided by UCR Energy and Sustainability staff will be used to project future EUIs and solar photovoltaic capacity of main campus buildings. EUI vary by building type; therefore, existing buildings and associated EUIs will be categorized by building types within each LRDP land use designation. Square-footage projections outlined in the 2021 LRDP provided by the LRDP team will be combined with existing square footage and EUI trends by building type to forecast total energy usage of campus buildings, including reduction from planned building demolitions. EUIs for future buildings will be adjusted to account for Title 24 efficiency standards and UCOP green building policy impacts (20 percent beyond Title 24). Additionally, to account for the continuing effects of the RPS, the energy intensity factors (i.e., the amount of CO_2, CH_4, and N_2O per kilowatt-hour) included in CalEEMod modeling will be reduced based on the percentage of renewables reported by RPU.

Scope 3 Emissions

Business Travel

Emissions generated from business travel associated with faculty and staff air travel will be forecasted based on 2021 LRDP anticipated growth of faculty population and adjusted to account for the anticipated improvement in aviation fuel efficiency improvements. Based on a study by the Federal Aviation Administration (FAA), aircraft fuel efficiency has improved by approximately one percent per year and is anticipated to continue.

On-site Transportation

Mobile source emissions from on-site transportation, excluding the UCR fleet that is included separately under Scope 1 emissions, will be based on forecasted VMT based on the travel demand model RivTAM and on-site traffic counts provided by F&P. Mobile emissions generated from employee commute and public transit (RTA) will be forecasted based on the 2021 LRDP-anticipated growth of student employees and staff population and emission factors from the EMFAC 2017 model based on the forecasted calendar year.

Construction

Construction/demolition emissions related to construction equipment fuel and electricity use will be based on building square footage to be demolished provided by UCR, default model input based on the LRDP building type and projected gross square footage, and anticipated date range of demolition or construction provided by UCR. To develop a reasonable average emission factor for demolition and construction by building type, CalEEMod will be used to model demolition and new construction of buildings of different scales (e.g., number of levels, square footage by building) and across different years. Although UCR has indicated that Tier IV construction equipment is used on campus during construction projects, only State legislation will be considered in the adjusted forecast scenario. As such, UCR specific construction equipment policies will not be incorporated into the construction emissions modeling, thereby providing a conservative estimate related to construction emissions. However, such policies will be considered during the GHGRS measure development and quantification where emission reductions from such polices will be quantified to demonstrate the impact of UCR actions and policies on GHG emission reduction strategies.

Waste Generation

Solid waste emissions generated on-campus will be forecasted based on LRDP anticipated growth of students and staff population.

Interim Projects Emissions

Scope 1, 2, and 3 Emissions

There are several interim projects that have occurred/are occurring on the UCR main campus within the boundary of the 2021 LRDP post the 2018 calendar year and, therefore, would not be accounted for within the 2018 baseline GHG inventory. As these projects are under UCR operational control and are within the 2021 LRDP area though not formally included in the 2021 LRDP, the operational and construction emissions associated with these interim projects will be added to the GHG emissions forecasting to provide an all-encompassing and, thus, conservative forecast for the UCR main campus. The 2030 forecast, specifically, will account for the construction and operational emissions associated with the interim projects between 2018 and 2020.

Construction and operational GHG emissions associated with the interim projects have already been quantified in separate standalone UCR project-level CEQA documents using CalEEMod, and the respective results have been provided to Rincon by UCR for use in the GHG emissions 2030 forecast. The interim projects emissions for the 2030 forecast will be calculated and provided in a similar scope emissions category manner as explained above for the UCR 2021 LRDP emissions inventory.

Subsequent to the completion of the Greenhouse Gas Emissions Inventory and Forecast Data Evaluation Memorandum sent to UCR on May 15, 2020, two projects, the Class Lab & Teaching Facility and School of Business were removed from the interim projects category, as it has been confirmed that these two projects are already incorporated into the 2021 LRDP program model.[26]

Therefore, Rincon ultimately received a list of eleven interim projects that were constructed post-2018 and are not included in the 2021 LRDP, but that will be included in the 2030 forecast.[27] The interim projects include: North District Development (NDD) Phase 1, North District Development (NDD) Phases 2-5, Dundee Glasgow, The Barn, Plant Growth Environments Facility (PGEF), Student Success Center (SSC), Parking Structure 1 (PS1), Pierce Hall Renovation, Batchelor Hall Renovation, Student Health & Counseling Center, and School of Medicine Building 2.

Conclusion

The data provided by UCR and summarized in this Data Evaluation Memorandum serve as the basis for the baseline GHG Inventory (2018) and future emissions forecasts (2030, 2035, and 2045) that will support the 2021 UCR LRDP Greenhouse Gas Reduction Strategy (GHGRS). Table 6 summarizes the status of receipt of data for preparation of the GHG inventory and forecasts.

[26] Email communication with Stephanie Tang, UCR Campus Planner, on June 26, 2020.
[27] The list of interim projects including associated CEQA documentation of construction and demolition emissions was provided to Rincon on April 21, 2020 and clarified on June 24, 2020.

Table 6 UCR 2021 LRDP GHG Inventory and Forecast Data Receipt Summary Table

	Status for 2018 Inventory	*Status for 2030 Forecast*	*Status for 2035 Forecast*	*Status for 2045 Forecast*
Scope 1 Emissions				
Stationary Fuel (Natural Gas) Combustion Operational Data[1]	Received from UCR on April 23, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Other (Diesel) Stationary Fuel Combustion Data[2]	Received from UCR on April 21, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Mobile Fuel Combustion Operational Data	Received from UCR on February 26, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Process and Fugitive Emissions Operational Data[3]	Received from UCR on April 8, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Scope 2 Emissions				
Electricity Consumption Operational Data[1]	Received from UCR on April 23, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Electricity Generation Operational Data[1]	Received from UCR on April 23, 2020	Will be calculated based on forecasted campus development in 2021 LRDP		
Scope 3 Emissions				
Business Air Travel Data	Received from UCR on February 27, 2020	Will be calculated based on forecasted campus demographic growth in 2021 LRDP		
On-site Transportation				
All Non-transit Vehicle Travel	Received from F&P on May 13, 2020	Received from F&P by May 29, 2020	Received from F&P by May 29, 2020	Received from F&P by May 29, 2020
Transit Vehicle Travel	Received from UCR on April 21, 2020	Will be calculated based on forecasted campus demographic growth in 2021 LRDP		
Staff/Student Commute Subset	Received from UCR on April 21, 2020	Will be calculated based on forecasted campus demographic growth in 2021 LRDP		
Waste Generation	Received from UCR on February 7, 2020	Will be calculated based on forecasted campus demographic growth in 2021 LRDP		
Forecast Data				
Demographics	Received from UCR on February 3, 2020			
Campus Development	Received from UCR on February 3, 2020			
Development Projects[3] **(construction/demolition)**	Received from UCR on March 26, 2020			
Building Energy[4]	Received from UCR on April 21, 2020			
Interim Projects	N/A	Received from UCR on April 8, 2020	N/A	N/A

Source: Data compiled by Rincon in May 2020.

1. Campus-wide UCR utility data was originally received December 18, 2019; Rincon requested the data to be disaggregated based on the LRDP boundary during the January 31st, 2020 Scoping Meeting. Utility data disaggregated by LRDP boundary from total UCR utility use was received on April 23, 2020.
2. Refrigerant emissions data was originally received February 7, 2020. For use in the 2021 LRDP inventory Rincon requested that the refrigerant inventory be disaggregated based on the LRDP boundary during the March 24, 2020 Methodology Overview Meeting. Disaggregated refrigerant data specific to the LRDP boundary was received April 8, 2020.
3. During the January 31, 2020 Scoping Meeting, Rincon requested kmz maps indicating the baseline buildings included in the 2021 LRDP as well as the future land use changes based on building development. The original kmz maps were provided February 26, 2020. Rincon requested spreadsheets to be provided with the kmz maps that included building square footage necessary for forecasting; this was provided on March 26, 2020.
4. Building energy analysis data requested for future building operations was originally provided on March 6, 2020. For use in the 2021 LRDP inventory Rincon requested the building use intensity factors be provided in a excel format and sorted based on the 2021 LRDP land use designations to allow for forecasting. The complete disaggregated building energy information was provided on April 21, 2020.

Based on Rincon's review of the provided data, it appears that the data is generally complete and appropriate for use in preparation of the baseline GHG inventory and future emissions forecasts as detailed above. Upon review and approval of this Data Evaluation Memorandum by UCR, Rincon will finalize the baseline GHG inventory and subsequently proceed with the future emissions forecasts and target setting, all of which will also be provided to UCR for review and approval. Please let us know if you have any questions or concerns with the data and methodology proposed for use in preparing the UCR GHG inventory and forecasts.

Sincerely,
Rincon Consultants, Inc.

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