Appendix D. GHG Inventory and Forecasts

In July 2019, Ascent Environmental prepared greenhouse gas (GHG) inventories for the Cities of Davis, Winters, and Woodland on behalf of Yolo County. The Davis inventory reflected calendar year 2016 GHG emissions conditions. As part of the subsequent City of Davis Climate Action and Adaptation Plan (CAAP) development process, the on-road transportation emissions from the original 2016 GHG inventory were updated to better align with CAAP planning efforts and to leverage 'big data' to understand the origin and destination of trips that start and end within the city's boundary. The CAAP planning team developed two technical memorandums (presented in this appendix), including an updated estimate for the 2016 vehicle miles traveled (VMT) and new 2040 VMT forecasts to support CAAP analysis and an origin-destination study to evaluate travel patterns to and from the city to inform CAAP action development. Through the CAAP planning process a revised 2016 GHG inventory was developed based on the updated 2016 VMT estimates; the remainder of the original 2016 inventory was unchanged. The revised 2016 GHG inventory was then used as the starting point to develop the CAAP's 2030 and 2040 GHG forecasts.

This appendix presents the final 2016 GHG inventory results and forecasting assumptions and results used in the CAAP analysis. It also presents the results and methodology from the original 2016 GHG inventory, the 2016 and 2040 VMT estimates, and the origin-destination travel study. This appendix is organized into the following four sections:

1. City of Davis Final 2016 GHG Inventory and Forecasts
2. Yolo County Regional Greenhouse Gas Emissions Inventory Update for the Cities of Davis, Winters, and Woodland – Draft Technical Memorandum
3. City of Davis Vehicle Miles Traveled (VMT) Estimates Memorandum
4. City of Davis Origin-Destination Travel Patterns

Section 1
City of Davis Final 2016 GHG Inventory and Forecasts

Table 1 presents the revised 2016 GHG inventory that is evaluated in the CAAP. It lists emissions sectors, activity data, GHG emissions results, and relative contribution to the total inventory. As described in the appendix introduction, the initial 2016 inventory was developed as presented in Section 2, with the on-road transportation sector emissions revised during CAAP development based on VMT estimates presented in Section 3.

Table 1. Final 2016 GHG Inventory

Emissions Sector	Activity Data	Emissions (MT CO_2e)	Community-wide Total
Residential Electricity	134,849 megawatt hours (MWh)	18,005	3%
Residential Natural Gas	789,270 metric million British thermal units (MMBtu)	42,003	7%
Commercial Electricity	89,057 MWh	11,891	2%
Commercial Natural Gas	272,555 MMBtu	14,505	3%
On-Road Transportation	1,105,196,460 VMT[1]	421,357	74%
Off-Road Equipment	NA	24,825	4%
Solid Waste	35,524 tons	14,609	3%
Water Supply	3,863,258 kilowatt-hours	518	<1%
Wastewater	67,446 people	19,286	3%
Total[2]		**567,000**	**100%**

[1] Based on 2016 full accounting VMT from Appendix D, Section 3, Table 1 and an annualization factor of 332.

[2] Columns may not sum to totals shown due to rounding.

Table 2 presents the growth indicators and data sources used to develop the 2030 and 2040 GHG emissions forecasts analyzed in the CAAP.

Table 2. Greenhouse Gas Forecast Growth Indicators and Sources

Emissions Source	Growth Indicator	Source
Residential Electricity	Activity Data: Population	State of California Department of Finance 2021 (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households)
	Emissions Factor: Interpolation from 2016 emissions factor to 2045 carbon-free emissions factor (zero) per California Renewables Portfolio Standard (RPS) requirement	Yolo County Regional GHG Emissions Inventory (Ascent 2020) 2045 RPS Target (Senate Bill 100, 2018)
Residential Natural Gas	Population	State of California Department of Finance 2021 (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households)
Commercial Electricity	Activity Data: Service Population (population + employees)	State of California Department of Finance 2021 (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households and employees)
	Emissions Factor: Interpolation from 2016 emissions factor to 2045 carbon-free emissions factor (zero) per California RPS requirement	Yolo County Regional GHG Emissions Inventory (Ascent 2020) 2045 RPS Target (Senate Bill 100, 2018)

Emissions Source	Growth Indicator	Source
Commercial Natural Gas	Service Population	California Department of Finance 2021 (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households and employees)
On-Road Transportation	Activity data: SACSIM19 travel demand model	SACSIM19 Travel Demand Model (SACOG 2020)
	Emissions Factor: EMFAC model	CARB EMFAC v1.0.1
Off-Road Equipment	Population, Employment, Housing Units	California Department of Finance (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households and employees)
Solid Waste	Service Population	California Department of Finance (persons per household) SACSIM19 Travel Demand Model (SACOG 2020) (households and employees)
Water Supply		
Wastewater		

Table 3 presents the 2030 and 2040 emissions forecast results.

Table 3. 2030 and 2040 GHG Forecasts by Emission Sector

Emissions Sector	2030 Emissions (MT CO_2e)	2040 Emissions (MT CO_2e)
Residential Electricity	19,518	20,599
Residential Natural Gas	45,533	48,054
Commercial Electricity	12,771	13,399
Commercial Natural Gas	15,578	16,345
On-Road Transportation	327,283	290,825
Off-Road Equipment	26,249	27,267
Solid Waste	15,690	16,462
Water Supply	556	584
Wastewater	20,713	21,732
Total	**483,891**	**455,267**

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Section 2

Yolo County Regional Greenhouse Gas Emissions Inventory Update for the Cities of Davis, Winters, and Woodland – Draft Technical Memorandum

Memo

455 Capitol Mall, Suite 300
Sacramento, CA 95814
916.444-7301

Date: April 30, 2020

To: Taro Echiburu, Director, Yolo County Department of Community Services

Cc: Kimberly Villa and Eric Will, County of Yolo
Kerry Loux and Emily Severeid, City of Davis
Carol Scianna and Christopher Flores, City of Winters
Ken Loman and Reyna Pinon, City of Woodland

From: Angie Xiong, Dan Krekelberg, and Honey Walters

Subject: Yolo County Regional Greenhouse Gas Emissions Inventory Update for the Cities of Davis, Winters and Woodland – Draft Technical Memorandum

INTRODUCTION

In July 2019, the Yolo County Board of Supervisors approved a contract for Ascent Environmental (Ascent) to prepare greenhouse gas (GHG) emissions inventories for the cities of Davis, Winters, and Woodland to promote consistency between jurisdictions and support a regional approach to climate action planning. The contract included development of a GHG inventory tool, used to produce the results described in this report that will allow the cities to update calculations in the future. Ascent updated the inventories for the cities to a 2016 baseline year using new data sources, emissions factors, and methodologies. This technical memorandum summarizes the inventories; provides informative graphics to illustrate the share of GHG emission for each city and by emissions sector; and includes a detailed description of the data, methods, and assumptions used to achieve these results.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of two main parts:

- **Section 1, “Summary of Inventory Results,”** presents an overview of the GHG inventory results for each city, including tables and charts. It also compares annual regional GHG emissions by jurisdiction.
- **Section 2, “Data, Methods, and Assumptions,”** summarizes the data inputs, methodology, and assumptions used in the GHG inventories, by sector.

1 SUMMARY OF INVENTORY RESULTS

1.1 INVENTORY RESULTS

Results from the three communitywide GHG emissions inventories for the cities of Davis, Winters, and Woodland are shown in Table 1 and Figures 1–3. The largest proportion of GHG emissions for each jurisdiction in 2016 came from the On-Road Transportation sector, followed by the Building Energy sector, consistent with statewide trends.

Table 1 GHG Emissions by Sector for the Cities of Davis, Winters and Woodland in 2016

Sector	City of Davis		City of Winters		City of Woodland	
	GHG Emissions (MT CO_2e)	Percent of Annual Total	GHG Emissions (MT CO_2e)	Percent of Annual Total	GHG Emissions (MT CO_2e)	Percent of Annual Total
Building Energy	86,405	18	8,236	12	87,012	26
On-Road Transportation	321,955	69	54,550	81	193,849	59
Off-Road Transportation	24,825	5	2,451	4	20,426	6
Solid Waste	14,609	3	2,272	3	27,308	8
Water	19,804	4	239	<1	1,999	<1
Total	467,598	100	67,748	100	330,594	100

Notes: CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; MT= metric tons.

Columns may not add to totals because of rounding.

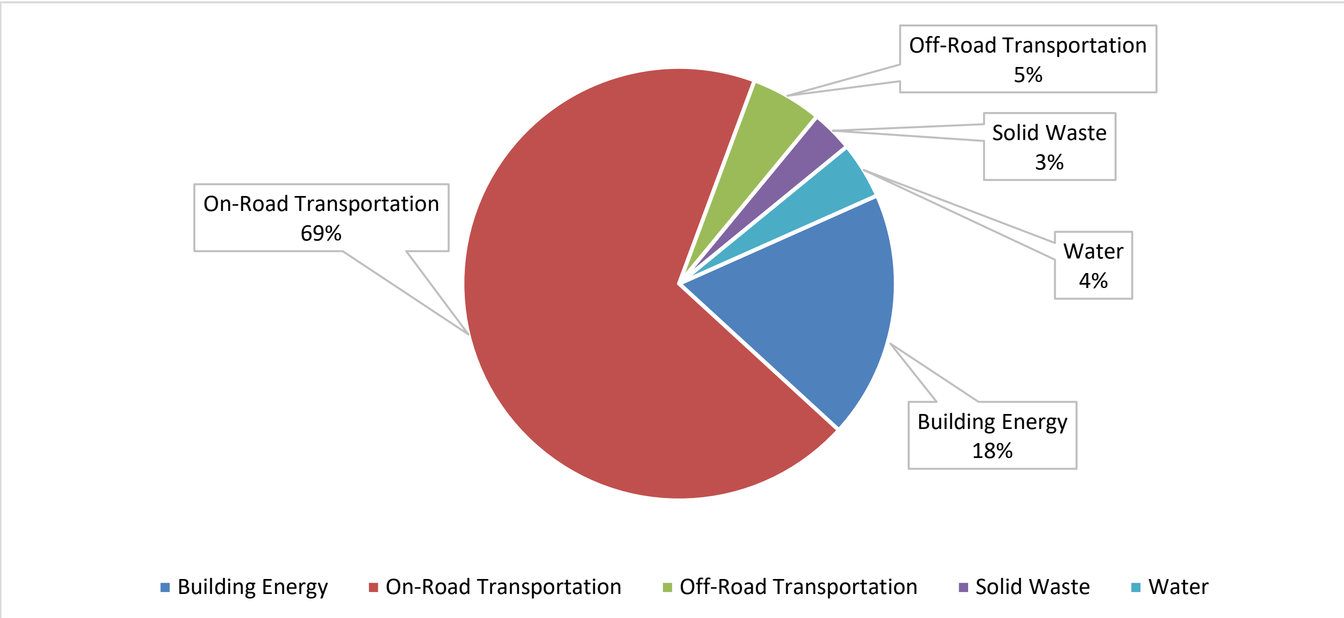
Source: Data compiled by Ascent Environmental in 2020

The Building Energy sector covers electricity and natural gas use from all nongovernmental commercial and residential buildings. Although the cities also contain industrial energy users, this type of energy consumption data is subject to the California Public Utilities Commission's (CPUC's) 15/15 Rule, which was adopted to protect customer confidentiality. The 15/15 Rule requires that any aggregated information provided by the utilities must be made up of information from at least 15 customers (100 for residential sectors) and that a single customer's load must be less than 15 percent of an assigned category.

The Solid Waste sector focuses on waste generation, which covers annual GHG emissions from all waste generated by a community, including community-generated waste disposed of within the community's boundaries or transferred to landfills outside the community. Gases are also released as waste in landfills decays over time; this is called waste-in-place. Waste-in-place emissions include the annual GHG emissions released from landfills located in a community. Emissions are calculated using historical information about the number of tons disposed of in the landfill since its opening; the composition of the waste; and the use of management practices, such as landfill gas management, that seek to mitigate the release of GHGs. Waste-in-place data were limited or unavailable for the cities of Davis, Winters, and Woodland; thus, this category of emissions was not included in the analysis. Landfills in these jurisdictions were closed decades ago, and no retroactive review of waste deposited historically has been conducted. Furthermore, the cities have limited control over landfill practices outside of their jurisdiction, and landfills, which are the major source of solid waste–related GHG emissions, are already addressed in Yolo County's climate action plan.

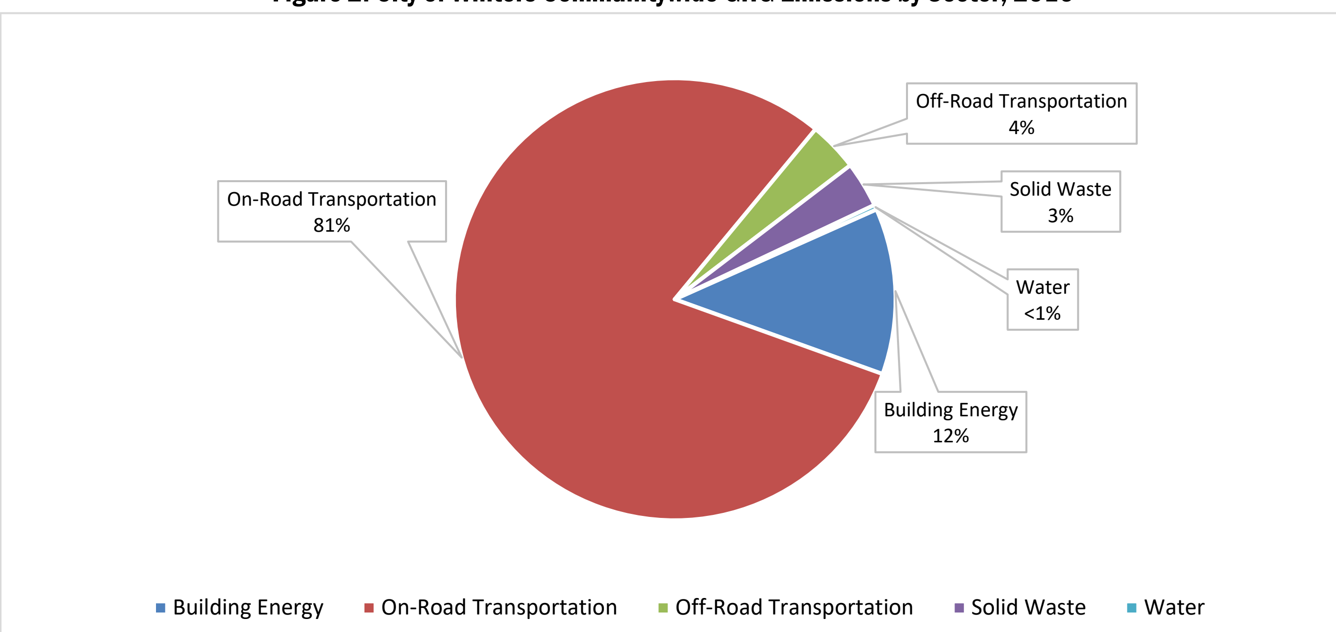
The Water sector includes electricity associated with water supplies, as well as process and fugitive emissions associated with wastewater treatment. Process emissions are associated with industrial processes and result from physical or chemical processing rather than from fuel combustion. Fugitive emissions are not physically controlled but result from the intentional or unintentional release of GHGs. Examples include methane (CH_4) from wastewater treatment lagoons or solid waste landfills.

Figure 1: City of Davis Communitywide GHG Emissions by Sector, 2016



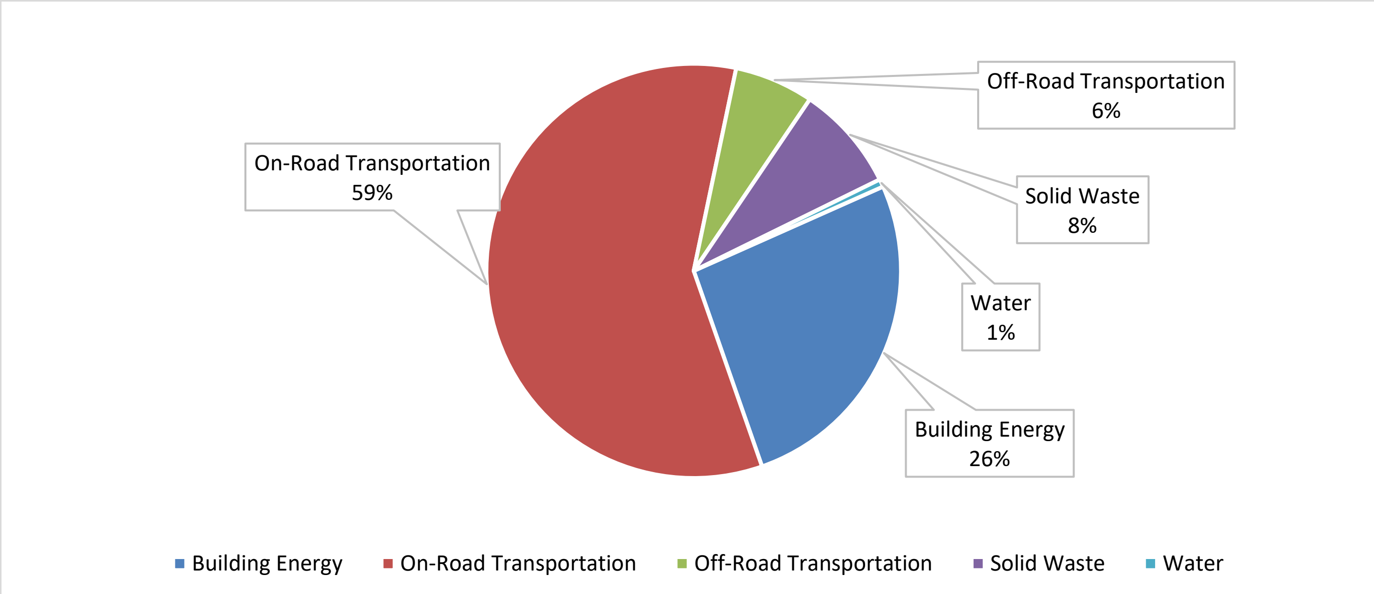
Source: Data compiled by Ascent Environmental in 2020

Figure 2: City of Winters Communitywide GHG Emissions by Sector, 2016



Source: Data compiled by Ascent Environmental in 2020

Figure 3: City of Woodland Communitywide GHG Emissions by Sector, 2016



Source: Data compiled by Ascent Environmental in 2020

Table 2 presents a comparison of annual regional GHG emissions by jurisdiction.

Table 2 Regional GHG Emissions Comparison

Community	GHG Emissions ($MT\ CO_2e$)	Percent of Estimated Regional Total
Davis	467,598	20
West Sacramento	365,140	16
Winters	67,748	3
Woodland	330,594	14
Yolo County - Unincorporated	1,082,801	47
Total – Regional	2,313,881	100

Notes: CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; MT= metric tons.

Yolo County - Unincorporated includes emissions from the Agricultural sector. The information presented for the city of West Sacramento is from a 2011 baseline.

Source: Data compiled by Ascent Environmental in 2020

2 DATA, METHODS, AND ASSUMPTIONS

GHG inventories were previously prepared for the cities with baseline years of 2012 for Davis, 2005 for Winters, and 2005 for Woodland. Since then, new protocols have been developed for calculating communitywide GHG emissions in various sectors. These changes reflect refinements in the planning process that have resulted from research in the field and shared knowledge from local governments engaged in climate action planning. The International Council for Local Environmental Initiatives (ICLEI) develops guidance for local-scale accounting of emissions that many local governments are now using to develop their GHG inventories. The most recent guidance for community-scale emissions inventories is ICLEI's July 2019 publication *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (ICLEI 2019). The GHG inventories and the GHG inventory tool were developed in accordance with the methodologies presented in ICLEI's July 2019 protocol. The 2019 protocol is similar to the 2013 U.S. community protocol used by Ascent for Yolo County's GHG inventory, with the only substantial difference that the 2019 protocol includes a chapter for quantifying GHGs associated with forests, which is not applicable to the incorporated cities covered in this analysis.

The calculations relied on data provided by the cities of Davis, Winters, and Woodland; sector-specific sources of information; and The Climate Registry's default emission factors and global warming potential (GWP) figures from the Intergovernmental Panel on Climate Change's (IPCC's) Fifth Assessment Report (AR5). In the past decade, there has been much research on the GWP values of various emissions. In 2014, the IPCC released AR5, which adjusted GWP values for CH_4 and nitrous oxide (N_2O), as well as other substances regulated by the Montreal Protocol (Myhre et al. 2013). In most equations associated with GHG accounting protocols, CH_4 and N_2O emissions are adjusted for GWP and combined with carbon dioxide (CO_2) to determine carbon dioxide equivalents (CO_2e), the common metric used to measure GHG emissions. Because GWP values are multipliers, small changes to these values can influence the resultant calculations. The GHG inventory tools for each city were developed so that the GWP values may be easily adjusted in the "Assumptions" tab to use GWP figures from prior IPCC reports. This feature can be useful for comparing communitywide GHG inventories to CARB's 2016 statewide GHG inventory, which was calculated using GWPs from the IPCC's Fourth Assessment Report. The GHG inventory tool can also incorporate updated values from future IPCC assessment reports.

2.1 BUILDING ENERGY

2.1.1 Residential Energy Consumption

GHG emissions in the residential energy subsector result from the consumption of natural gas and electricity in single-family, multifamily, and mixed-use buildings. These energy resources are used for lighting, air-conditioning, space and water heating, and the operation of appliances and electronics. Community energy use data for residential building types in the cities of Davis, Winters, and Woodland were provided by the Pacific Gas & Electric Company (PG&E) for 2009–2018 and included City, District, and Non-Government classification types. Non-Government figures from 2016 were used for this inventory update. Energy use metrics included natural gas, expressed as million metric British thermal units, and electricity, expressed as kilowatt hours (kWh). To calculate the CO_2e of residential energy consumption, fuel use was converted to CO_2, CH_4, and N_2O emissions using emissions factors for natural gas and electricity generation from PG&E, eGrid, and The Climate Registry. CH_4 and N_2O emissions were translated into CO_2e by multiplying those figures by AR5 GWPs and summed to show CO_2e for natural gas and electricity consumption in residential uses.

2.1.2 Commercial Energy Consumption

GHG emissions in the Commercial Energy subsector result from the consumption of natural gas and electricity in privately owned office buildings, shopping centers, and other nonresidential uses. Electricity covers all retail customers supplied power by PG&E. Commercial energy consumption data were provided by PG&E and included natural gas and electricity delivered to City, District, and Non-Government customers from 2009 to 2018. Non-Government figures from 2016 were used for Davis's and Woodland's GHG inventories. No data were provided in 2016 for nongovernmental customers in the city of Winters because of CPUC's 15/15 Rule, as discussed in Section 1.1, which prohibits the release of energy data if the sample size is not large enough to ensure anonymity. The ICLEI community protocol for GHGs provides guidance on estimating commercial fuel use in years for which consumption data are not available, but this guidance is limited to fuel oils, which are not commonly used in California. Thus, natural gas consumption data from 2011 and electricity consumption data from 2014 (the most recent years available) were used to complete Winters's inventory for the Commercial Energy subsector.

2.2 TRANSPORTATION

2.2.1 On-Road Transportation

GHG emissions in the On-Road Transportation sector result from fuel combustion in on-road vehicles, which include passenger vehicles (i.e., cars and light-duty trucks), medium- and heavy-duty trucks, motorcycles, and other types of vehicles permitted to operate "on-road." Ascent requested a customized vehicle miles traveled (VMT) data set from the region's metropolitan planning organization, the Sacramento Area Council of Governments (SACOG). SACOG publishes the region's Metropolitan Transportation Plan (MTP) and has developed a Senate Bill 375 Regional Targets Advisory Committee–compliant model called the Sacramento Activity-Based Travel Simulation (SACSIM) model to estimate VMT in the Sacramento region, including for cities in Yolo County. An update to the regional MTP in 2019 used 2016 as a baseline year for VMT, using a model similar to those used in previous plans. Ascent requested VMT data by speed bin from 2016 for the cities of Davis, Winters, and Woodland. Updated emission factors by speed bin were obtained from EMFAC 2017 and were used to calculate the CO_2e for 2016.

In March 2020, the U.S. Environmental Protection Agency (EPA) issued the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks. The final rule reduces the annual fuel economy improvement required for new passenger cars and light trucks from 5 percent to 1.5 percent and assumes no increase in electric vehicle sales share by 2026 beyond the current level of 2 percent. These adjustments could have an effect on the accuracy of projected on-road transportation emission factors for future years. The long-term GHG implications of the SAFE rule are still being determined. An adjustment factor for the SAFE rule's effect on EMFAC 2017 was released in late 2019; however, this approach covers criteria air pollutants only, not GHG emissions (CARB 2019).

2.2.2 Off-Road Transportation

GHG emissions in the Off-Road Transportation sector result from fuel combustion associated with vehicles, heavy equipment, and machinery operating off paved roads. GHG emissions for this sector were estimated using a CARB-approved modeling tool called OFFROAD 2007, which provides CO_2, CH_4, and N_2O emissions for several categories of off-road equipment for Yolo County. The following equipment categories were excluded from the analysis because they are not relevant for urban environments: Logging Equipment, Airport Ground Support, Military Tactical Support Equipment, Oil Drilling, and Dredging. Categories that were included in the GHG inventories were:

- Agricultural Equipment,
- Construction and Mining Equipment,
- Entertainment Equipment,
- Industrial Equipment,
- Lawn and Garden Equipment,
- Light Commercial Equipment,
- Pleasure Craft,
- Railyard Operations,
- Recreational Equipment, and
- Transport Refrigeration Units.

Because OFFROAD 2007 provides data at the county level, these emissions were scaled using demographic data, employment data, and land use acreages to estimate each city's proportion of the total county off-road emissions. These estimates were then multiplied by AR5 GWP values and summed to calculate annual CO_2e.

2.3 SOLID WASTE

GHG emissions in the Solid Waste sector result from fuels combusted in the equipment used to transport and process waste and from gases released as waste in landfills decays over time. These processes are categorized into two subsectors: waste generation and waste-in-place. As discussed in Section 1.1, waste-in-place was omitted from this analysis.

To estimate waste generation for the GHG inventories, Ascent used the U.S. Community Protocol's SW.4 method. This method calculates CO_2e from the annual waste generated by a community, including waste exported to landfills outside a community's boundaries. Data were obtained using the California Department of Resources Recycling and Recovery's Jurisdiction Disposal and Alternative Daily Cover Tons by Facility reporting tool. This tool shows the total amount disposed of by a jurisdiction at each disposal facility for a requested year. The tonnage of waste attributed to each city was converted to CH_4 using the EPA AP-42 conversion factor for tonnage to CH_4 which assumes the material is mixed solid waste composed of materials typically disposed at landfills nationwide. The CH_4 output was adjusted for facilities using landfill gas capture systems and then converted to CO_2e using GWP values from AR5.

2.4 WATER

2.4.1 Water Supply

GHG emissions from water consumption are associated with electricity used for water conveyance, treatment, and delivery. The cities of Davis and Woodland are supplied by the Woodland-Davis Clean Water Agency, and the city of Winters is supplied by the city's Public Works Department. The 2016 water consumption data were provided by the cities and converted into acre-feet of water per year. A 2015 report prepared for the CPUC analyzed the average energy intensity of water for several hydrologic regions and estimates the energy intensity of water supplied in the Sacramento River region to be 423 kWh per acre-foot. Total electricity use was calculated by multiplying water consumption by the energy intensity of water consumption. The CO_2e emissions of electricity used to supply water were then calculated using the same emission factors and methods as those used in the Building Energy subsector for electricity consumption.

2.4.2 Wastewater Treatment

Emissions associated with the treatment of sewage are highly dependent on the processes and components used by specific wastewater treatment plants (WWTPs), such as septic tanks, lagoons, centralized systems, and digester gas or combustion devices. To calculate emissions for this subsector, jurisdiction-specific data regarding the type of WWTP and population served are required. If the WWTP employs anaerobic or facultative lagoons to treat wastewater, the average biological oxygen demand (BOD) of the wastewater in kilograms per day is also required. BOD represents the amount of oxygen consumed by bacteria and other microorganisms while organic matter decomposes and is used as an index of the degree of organic pollution in water.

Process CH_4 emissions were calculated by inputting BOD data and relying on the 2019 ICLEI U.S. community protocol Equation WW.6 for anaerobic or facultative lagoons. Equation WW.6 contains factors for the maximum CH_4 production capacity of domestic wastewater and a CH_4 correction factor for anaerobic systems. Process N_2O emissions were calculated by inputting population data and relying on the 2019 ICLEI U.S. community protocol Equation WW.8 for centralized WWTPs without nitrification or denitrification. Equation WW.8 contains nitrogen loading factors and WWTP emission factors. Fugitive N_2O emissions were calculated by inputting population data and relying on the 2019 ICLEI U.S. community protocol Equation WW.12(alt) for effluent discharge to receiving aquatic environments. Equation WW.12(alt) contains factors for average total per capita nitrogen load per day, amount of per capita BOD per day, and emission factors for sewage discharge.

Wastewater process emissions from the city of Davis WWTP include process CH_4 emissions from facultative lagoons, process N_2O emissions from primary and secondary treatment, and fugitive N_2O emissions from effluent discharge. Population data were obtained from the California Department of Finance (CDF) (CDF 2019), and BOD data (a 5-year average from 2010 to 2015) were obtained from a technical memorandum prepared for the city regarding the impacts of the Innovation Center and Nishi property developments on WWTP capacity (West Yost Associates 2015).

The city of Winters operates a secondary aerobic WWTP without nitrification or denitrification and without the use of lagoons or septic tanks. An aerobic plant is one that depends on the use of bacteria to break down the organic matter in the water in the presence of oxygen. If sufficient oxygen is provided for the bacteria by aerating the basins during secondary treatment, the organic matter can break down without releasing significant quantities of CH_4. To provide enough oxygen, the Winters WWTP ponds are aerated and maintained at a specified depth. The depth is maintained by spraying treated water on the city field that surrounds the plant. Thus, wastewater process emissions from the city of Winters WWTP include process N_2O emissions from primary and secondary treatment and fugitive N_2O emissions from effluent discharge. Population data were obtained from the CDF (CDF 2019).

The city of Woodland operates a tertiary aerobic WWTP without nitrification or denitrification and without the use of lagoons or septic tanks. Effluent is discharged to the Tule Canal. Thus, wastewater process emissions from the city of Woodland WWTP include process N_2O emissions from primary and secondary treatment and fugitive N_2O emissions from effluent discharge. Population data were obtained from the CDF (CDF 2019).

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CARB. *See* California Air Resources Board.

CDF. *See* California Department of Finance.

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Section 3
City of Davis Vehicle Miles Traveled (VMT) Estimates Memorandum

FEHR & PEERS

Memorandum

Date: April 19, 2021

To: Diana Edwards & Josh Lathan, AECOM

From: Greg Behrens & Kashfia Nehrin, Fehr & Peers

Subject: City of Davis Vehicle Miles Traveled (VMT) Estimates

RS21-4010

This memorandum summarizes the methods and results of the vehicles miles traveled (VMT) estimates prepared by Fehr & Peers in support of the City of Davis Climate Action & Adaptation Plan (CAAP).

Methodology

Fehr & Peers prepared VMT estimates utilizing the SACSIM19 travel demand model. SACSIM19 was developed by the Sacramento Area Council of Governments (SACOG) to assist with the preparation and evaluation of the SACOG 2020 Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS). SACSIM19 is an activity-based model used to predict how people in the six-county SACOG region travel on a typical weekday, including where they go, when they make trips, why they make trips, and what travel mode or modes they use.

VMT estimates were prepared for 2016 and 2040 analysis scenarios. These analysis scenarios represent the land use and transportation system characteristics consistent with baseline (2016) and horizon year (2040) conditions identified by SACOG in the 2020 MTP/SCS.

The estimates represent VMT generated by the City of Davis during a typical weekday. Fehr & Peers utilized the origin-destination (OD) trip methodology, which accounts for VMT associated with trips that have at least one trip end in the City of Davis. Two types of VMT are reported using the OD trip methodology. First, a full accounting of all VMT generated by the City of Davis. Second, a partial accounting of VMT generated by the City of Davis, whereby trips that share trip ends across two jurisdictions (i.e., a trip from the City of Davis to unincorporated Yolo County) are discounted by 50 percent. The latter approach accepts the notion that for interjurisdictional VMT, each jurisdiction is only responsible for half of the VMT.

Results

Table 1 summarizes the estimated weekday VMT generated by the City of Davis for 2016 and 2040 analysis scenarios.

VMT is reported by speed bin for VMT on roadways within the SACSIM19 model boundary. VMT on roadways outside of the SACSIM19 model boundary was determined by appending the trip length of City-generated trips at each of the SACSIM19 model gateways. Because SACSIM19 does not provide information regarding speeds on roadways outside of the SACSIM19 model boundary, this VMT is reported as a single figure.

Table 1: City of Davis VMT Summary

VMT Category	2016		2040	
	Full Accounting	External Trip Reduction (50%)	Full Accounting	External Trip Reduction (50%)
VMT Inside of SACOG Region (by Speed Bin)				
0-5	446	266	1,916	1,161
>5-10	3,897	2,189	4,151	2,204
>10-15	4,430	2,354	7,930	4,284
>15-20	95,319	54,109	82,146	47,644
>20-25	94,966	62,705	99,655	66,163
>25-30	88,602	56,187	115,978	71,430
>30-35	149,660	86,708	159,710	90,844
>35-40	147,859	77,359	160,161	84,422
>40-45	208,266	106,034	204,228	103,984
>45-50	153,081	76,573	107,229	53,627
>50-55	281,761	141,018	330,461	165,351
>55-60	607,043	304,592	665,092	333,745
>60-65	263,014	132,508	284,363	143,177
>65-70	46,500	23,250	50,067	25,034
Subtotal	*2,144,843*	*1,125,852*	*2,273,087*	*1,193,069*
VMT Outside of SACOG Region	1,184,061	592,031	1,087,954	543,977
Total VMT	**3,328,905**	**1,717,883**	**3,361,041**	**1,737,046**

Note: VMT estimates prepared using SACSIM19 travel demand model.
Source: Fehr & Peers, 2021.

Potential Limitations to the Travel Demand Model

While the SACSIM model ranges from state-of-practice to advanced-practice in travel modeling, travel behavior and the transportation systems are changing quickly in response to emerging trends, new technologies, and different preferences. Some of the new travel options and technologies emerging in the SACOG region are discussed below. Additionally, information about how technology is affecting travel is accumulating over time. Some of these emergent changes that could influence future travel forecasts include:

- Substitution of internet shopping and home delivery for some shopping or meal-related travel.
  - The 2018 SACOG Household Travel Survey (HTS) showed that adults reported receiving a home delivery of a package on 17 percent of the travel days in the survey and an additional 4 percent received packages at work, food deliveries at home, etc. How these percentages compared to earlier years is not known.
  - The National Household Travel Survey (NHTS) showed the number of online purchases with home delivery doubling between 2009 and 2017, from about 2.5 to 4.9 per household per month (FHWA 2018).
  - Comparisons of 2017 to 2009 NHTS data show that nationally, non-work trips per household declined by 11 percent. Most of that decline is attributed to lower rates of shopping trips and other family-related errands (FHWA 2018).
- Substitution of telework for commute travel.
  - The 2018 SACOG HTS showed that 17 percent of the respondents reported working at home at least one day per week.
  - The permanent effects of telework on commute travel resulting from the on-going COVID-19 pandemic are not yet known.
- New travel modes and choices
  - Transportation network companies (TNCs), car share, bike share, scooter share, and on-demand micro transit have increased the travel options available to travelers in the SACOG region and have contributed to changes in traditional travel demand relationships. As noted above, the current share of resident trips served by TNCs is less than one-quarter percent, and future growth depends on TNCs developing a sustainable business model.
- Automation of vehicles
  - Both passenger vehicles and commercial vehicles and trucks are evolving to include more automation. Research, development, and deployment testing is proceeding on

fully autonomous vehicles (FAVs), for which no human driver would be required, and the vehicle itself can navigate the roadways to take people or goods where they need to go. Forecasts of how quickly research, development, and deployment testing will transition to full deployment and mass marketing of FAVs vary widely both on the pace of the transition, and the market acceptance of fully autonomous operation. More uncertainty exists for the behavioral response to FAVs. In terms of impact on the transportation system and the environment, a scenario of concern would be one in which FAVs are privately owned, like automobiles in the present, but the automated function of the vehicles would entice users to travel more. Examples of this phenomenon could include:

- Vehicles are repositioned to serve different members of a household (e.g., have a car drop a worker at their workplace, then drive back home empty to serve another trip, such as a student going to school). The repositioning of driverless vehicles could add significantly to traffic volumes and VMT.
- The time spent in a vehicle is re-evaluated by travelers, resulting in an increase in the willingness to make longer trips. For example, if a person could read or do work in a vehicle instead of focusing on driving, they might be willing to commute longer to work. Conversely, a worker who prefers to live in a rural area, but is unwilling to drive far enough to act on that preference in a conventional vehicle, may be willing to do so in an FAV.
- There may be an increasing willingness to drive more to avoid parking costs or tolls. For example, a person going to a sporting event in an area that charges for parking may use an FAV to be dropped off at the venue, with the FAV repositioning to an area that does not charge for parking.

- Connected vehicles
  - A connected vehicle (CV) can communicate wirelessly with its surroundings, including other vehicles, bicyclists, pedestrians, roadway infrastructure (i.e., traffic signals, toll facilities, traffic management facilities, etc.), and the internet. The influence that CVs may have is still speculative, but includes the potential for reductions in collisions and congestion, and greater overall network performance optimization.

SACSIM does not explicitly capture the above-mentioned new modes of travel and emerging trends in travel behavior. Through validation of the model to 2016 conditions, the cumulative effect of the new modes and changes are reflected in the resulting travel demand estimates, but the underlying behavioral impact of the modes are not modeled. Significant uncertainties exist at the present time that prevent explicit modeling of these new modes and emerging trends.

Additionally, future deployment levels for new modes of travel are unknown. For example, Uber and Lyft have both significantly increased trips, but both continue to run large operating losses and are reliant on investors to cover losses. A sustainable business model may require significant changes to services and/or fares, both of which could affect the trajectory of use and impact on travel behavior. Similar issues apply to bike share and other micro-mobility services.

The impact of new modes on individual and household travel behavior also is not fully understood and is the subject of ongoing research. Limitations on accessing utilization data directly from TNC vendors, in particular, constrains the ability to fully understand the impact of those services. Regulatory and legislative efforts to address the limits on access are underway in California and elsewhere, but these efforts will take time. Only a few household travel surveys, including the 2018 SACOG HTS, have surveyed TNC use in detail, and the e-assist JUMP bikes were introduced partway through the 2018 SACOG HTS. Other major research studies focused on TNC use, and TNC driver behavior, are just being launched in California, and data collection and analysis has not yet started. Until this research is completed, there is no effective way to incorporate even the known new modes into travel demand models.

SACOG is participating in some of the ongoing monitoring and research on the deployment and impact of new modes of travel and will incorporate analysis findings related to individual and household travel behavior into later versions of SACSIM.

Section 4

City of Davis Origin-Destination Travel Patterns

Memorandum

Date: April 11, 2022

To: Diana Edwards & Josh Lathan, AECOM

From: Greg Behrens, Fehr & Peers

Subject: City of Davis Origin-Destination Travel Patterns

RS21-4010

This memorandum summarizes the methods and results of the origin-destination travel pattern analysis prepared by Fehr & Peers in support of the City of Davis Climate Action & Adaptation Plan (CAAP).

Data Sources

This analysis relies on two primary data sources.

First, StreetLight Data was utilized to estimate origin-destination (O-D) patterns associated with vehicle trips that begin and/or end within the City of Davis. StreetLight Data[1] aggregates location data from smartphones and navigation devices to produce various travel metrics. The O-D data presented in this memo is from Fall 2019. This time period was selected for analysis because it represents the most recently available complete dataset prior to the COVID-19 pandemic.

Second, data from the US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) program was utilized to estimate work and home locations for workers who work and/or live within the City of Davis. This data was accessed through the US Census OnTheMap webtool.[2]

[1] Additional information about StreetLight Data's Origin-Destination metrics can be found at https://www.streetlightdata.com/origin-destination-od-study/.

[2] Additional information about the US Census Bureau OnTheMap webtool can be found at https://lehd.ces.census.gov/applications/help/onthemap.html#!what_is_onthemap.

Vehicle Trip Origin-Destination Travel Patterns

Tables 1 and 2 summarize the count and share, respectively, of total daily vehicle trips generated by the City of Davis. Trips are presented by day type and by trip type, including internal-internal trips (trips that begin and end within the Davis), internal-external trips (trips that begin in Davis and end elsewhere), and external-internal trips (trips that begin elsewhere and end in Davis). Trips are expressed in terms of trip ends to allow for comparisons across internal and external trip types.

On a daily basis, the City of Davis generates between approximately 258,000 and 349,000 vehicle trips. Fridays represent the busiest day type (349,183 trips) and Sundays represent the least busy day type (258,175 trips). Approximately, 315,000 trips are generated on a typical weekday.

On a typical weekday, 62 percent of total vehicle trips are internal-internal trips within the City of Davis and 12 percent of total vehicle trips travel between the City of Davis and the UC Davis main campus. Note that this represents a portion of overall travel demand internal to the City of Davis and between the City of Davis and UC Davis given the relatively high non-motorized mode share for these local trips. The remaining 26 percent of total vehicle trips are internal-external or external-internal trips between the City of Davis and locations elsewhere.

Table 1: City of Davis Daily Vehicle Trips, Count

Trip Type/Location	Day Type							
	Mon.	Tue.	Wed.	Thu.	Fri.	Typical Weekday[1]	Sat.	Sun.
Origin Davis, Destination Davis (Internal-Internal)								
Subtotal	190,032	193,472	201,108	195,434	224,082	196,784	196,404	173,308
Origin Davis, Destination Elsewhere (Internal-External)								
Davis to UC Davis	*18,323*	*18,506*	*18,325*	*17,484*	*15,856*	*18,089*	*7,655*	*7,046*
Davis to Other	*39,340*	*41,524*	*41,691*	*41,426*	*47,341*	*41,615*	*43,078*	*34,032*
Subtotal	57,663	60,030	60,016	58,910	63,197	59,704	50,733	41,078
Origin Elsewhere, Destination Davis (External-Internal)								
UC Davis to Davis	*18,572*	*18,959*	*18,584*	*17,650*	*16,218*	*18,380*	*8,748*	*7,412*
Other to Davis	*40,168*	*41,504*	*40,556*	*40,338*	*45,686*	*40,880*	*41,610*	*36,377*
Subtotal	58,740	60,463	59,140	57,988	61,904	59,260	50,358	43,789
All Trips								
Total	**306,435**	**313,965**	**320,264**	**312,332**	**349,183**	**315,748**	**297,495**	**258,175**

Notes: Trips represent vehicle trip ends. For example, a one-way trip has two trip ends (one origin and one destination). This approach allows for comparisons across internal and external trip types. Table only includes trip ends within the City of Davis. Estimates derived from StreetLight Data vehicle trip estimates for Fall 2019 (September through November 2019).
[1] Typical weekday represents aggregation of Tuesday, Wednesday, and Thursday trip data.
Sources: StreetLight Data, Fehr & Peers, 2021.

Table 2: City of Davis Daily Vehicle Trips, Share

Trip Type/Location	Day Type							
	Mon.	Tue.	Wed.	Thu.	Fri.	Typical Weekday[1]	Sat.	Sun.
Origin Davis, Destination Davis (Internal-Internal)								
Subtotal	62%	62%	63%	63%	64%	62%	66%	67%
Origin Davis, Destination Elsewhere (Internal-External)								
Davis to UC Davis	*6%*	*6%*	*6%*	*6%*	*5%*	*6%*	*3%*	*3%*
Davis to Other	*13%*	*13%*	*13%*	*13%*	*14%*	*13%*	*14%*	*13%*
Subtotal	19%	19%	19%	19%	18%	19%	17%	16%
Origin Elsewhere, Destination Davis (External-Internal)								
UC Davis to Davis	*6%*	*6%*	*6%*	*6%*	*5%*	*6%*	*3%*	*3%*
Other to Davis	*13%*	*13%*	*13%*	*13%*	*13%*	*13%*	*14%*	*14%*
Subtotal	19%	19%	18%	19%	18%	19%	17%	17%
All Trips								
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: Trips represent vehicle trip ends. For example, a one-way trip has two trip ends (one origin and one destination). This approach allows for comparisons across internal and external trip types. Table only includes trip ends within the City of Davis. Estimates derived from StreetLight Data vehicle trip estimates for Fall 2019 (September through November 2019).
[1] Typical weekday represents aggregation of Tuesday, Wednesday, and Thursday trip data.
Sources: StreetLight Data, Fehr & Peers, 2021.

Tables 3 and 4 summarize the count and share, respectively, of weekday, AM peak hour, and PM peak hour vehicle trips between the City of Davis and other common locations.

On a typical weekday, the most common O-D locations (in descending order) are the City of Davis (196,784 trips, 62 percent), UC Davis (36,469 trips, 12 percent), the City of Woodland (21,608 trips, 7 percent), the City of Sacramento (18,382 trips, 6 percent), the City of Vacaville (4,860 trips, 2 percent), the City of West Sacramento (4,822 trips, 2 percent), and the City of Dixon (4,676 trips, 2 percent).

The approximately 22,800 trips generated during the AM peak hour (8 AM to 9 AM) represent approximately 7 percent of daily trips. During the AM peak hour on a typical weekday, the most common O-D locations (in descending order) are the City of Davis (12,664 trips, 56 percent), UC Davis (3,301 trips, 14 percent), the City of Woodland (2,127 trips, 9 percent), the City of Sacramento (1,579 trips, 7 percent), the City of West Sacramento (506 trips, 2 percent), the City of Vacaville (418 trips, 2 percent), and the City of Dixon (389 trips, 2 percent).

The approximately 26,900 trips generated during the PM peak hour (5 PM to 6 PM) represent approximately 9 percent of daily trips. During the PM peak hour on a typical weekday, the most common O-D locations (in descending order) are the City of Davis (16,454 trips, 61 percent), UC Davis (2,886 trips, 11 percent), the City of Woodland (1,970 trips, 7 percent), the City of

Sacramento (1,966 trips, 7 percent), the City of Vacaville (449 trips, 2 percent), the City of West Sacramento (437 trips, 2 percent), and the City of Dixon (426 trips, 2 percent).

The data presented in Tables 3 and 4 also provide insights regarding the peak direction of travel during different times of the day. For example, during the AM peak hour, 90 percent of trips between the City of Davis and UC Davis are from the City of Davis to UC Davis, likely coinciding with the prominent morning commute travel pattern to campus for UC Davis students and employees. During the AM peak hour, trips to Davis outweigh those from Davis for trips generated by the City of Woodland (74/26 percent), the City of Winters (90/10 percent), the City of Dixon (70/30 percent), and the City of Fairfield (63/37 percent). Conversely, trips to Davis measure below those from Davis for trips generated by UC Davis (10/90 percent), the City of Sacramento (42/58 percent), the City of Vacaville (42/58 percent), and the City of Rancho Cordova (31/69 percent). The peak direction of travel is fairly balanced between trips to Davis and those from Davis for trips generated by the City of West Sacramento (53/47 percent) and the City of Roseville (49/51 percent). Generally, travel directionality trends during the PM peak hour are comparable to the inverse of those during the AM peak hour.

Note that several locations exhibit low or very low trip counts (e.g., the City of San Jose during the AM peak hour). While the exact cause of this result is not known and likely varies from location to location, there are several factors that could contribute to this result. First, low trip counts can result from O-D pairs that exhibit low sample sizes in the data used to inform the StreetLight Data travel metrics. Second, it is possible that this result could be an outcome of trip-chaining and the manner in which these trips are aggregated in the StreetLight Data dataset. For example, for a hypothetical commute trip that originates at a residence in Davis, stops by at a coffee shop in Vacaville, and then ends at a worksite in San Jose, this trip would appear as a Davis-Vacaville trip, not a Davis-San Jose trip.

Table 3: City of Davis Weekday Vehicle Trips, Origins and Destinations, Count

Origin/Destination Location		Typical Weekday[1] (Daily Total)			AM Peak Hour (8 AM to 9 AM)			PM Peak Hour (5 PM to 6 PM)		
		To Davis	From Davis	Total	To Davis	From Davis	Total	To Davis	From Davis	Total
Yolo County	*City of Davis*	*98,392*	*98,392*	*196,784*	*6,332*	*6,332*	*12,664*	*8,227*	*8,227*	*16,454*
	UC Davis	*18,380*	*18,089*	*36,469*	*344*	*2,957*	*3,301*	*1,943*	*943*	*2,886*
	City of Woodland	*10,676*	*10,932*	*21,608*	*1,579*	*548*	*2,127*	*887*	*1,083*	*1,970*
	City of West Sacramento	*2,391*	*2,431*	*4,822*	*268*	*238*	*506*	*238*	*199*	*437*
	City of Winters	*1,016*	*1,014*	*2,030*	*173*	*20*	*193*	*84*	*117*	*201*
	Other	*538*	*457*	*995*	*27*	*37*	*64*	*55*	*45*	*100*
	Subtotal	131,393	131,315	262,708	8,723	10,132	18,855	11,434	10,614	22,048
Sacramento Region (excluding Yolo Co.)[2]	*City of Sacramento*	*9,269*	*9,113*	*18,382*	*665*	*914*	*1,579*	*1,288*	*678*	*1,966*
	City of Roseville	*707*	*718*	*1,425*	*30*	*31*	*61*	*66*	*67*	*133*
	City of Elk Grove	*755*	*793*	*1,548*	*78*	*54*	*132*	*77*	*73*	*150*
	City of Folsom	*242*	*229*	*471*	*12*	*12*	*24*	*34*	*19*	*53*
	City of Rancho Cordova	*488*	*456*	*944*	*28*	*62*	*90*	*29*	*23*	*52*
	Other	*5,169*	*5,568*	*10,737*	*360*	*292*	*652*	*409*	*392*	*801*
	Subtotal	16,630	16,877	33,507	1,173	1,365	2,538	1,903	1,252	3,155
Bay Area[3]	*City of Vacaville*	*2,376*	*2,484*	*4,860*	*177*	*241*	*418*	*236*	*213*	*449*
	City of Fairfield	*784*	*649*	*1,433*	*51*	*30*	*81*	*84*	*56*	*140*
	City of San Francisco	*265*	*243*	*508*	*6*	*10*	*16*	*14*	*16*	*30*
	City of San Jose	*95*	*137*	*232*	*4*	*4*	*8*	*9*	*15*	*24*
	City of Dixon	*2,334*	*2,342*	*4,676*	*273*	*116*	*389*	*213*	*213*	*426*
	Other	*3,042*	*3,183*	*6,225*	*216*	*178*	*394*	*303*	*232*	*535*
	Subtotal	8,896	9,038	17,934	727	579	1,306	859	745	1,604
San Joaquin Valley[4]	Subtotal	334	424	758	12	21	33	31	29	60
Central Sierra Nevada[5]	Subtotal	18	23	41	3	2	5	0	2	2
North Central Valley[6]	Subtotal	189	180	369	25	2	27	18	14	32
Other	Subtotal	192	239	431	1	18	19	15	6	21
	Total	**157,652**	**158,096**	**315,748**	**10,664**	**12,119**	**22,783**	**14,260**	**12,662**	**26,922**

Notes: Trips represent vehicle trip ends. For example, a one-way trip has two trip ends (one origin and one destination). This approach allows for comparisons across internal and external trip types. Table only includes trip ends within the City of Davis.
Estimates derived from StreetLight Data vehicle trip estimates for Fall 2019 (September through November 2019).
[1] Typical weekday represents aggregation of Tuesday, Wednesday, and Thursday trip data.
[2] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.
[3] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.
[4] Includes San Joaquin, Stanislaus, and Merced Counties.
[5] Includes Amador, Calaveras, and Tuolumne Counties.
[6] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.

Sources: StreetLight Data, Fehr & Peers, 2021.

Table 4: City of Davis Weekday Vehicle Trips, Origins and Destinations, Share

Origin/Destination Location		Typical Weekday[1] (Daily Total)			AM Peak Hour (8 AM to 9 AM)			PM Peak Hour (5 PM to 6 PM)		
		To Davis	From Davis	Total	To Davis	From Davis	Total	To Davis	From Davis	Total
Yolo County	*City of Davis*	*62%*	*62%*	*62%*	*59%*	*52%*	*56%*	*58%*	*65%*	*61%*
	UC Davis	*12%*	*11%*	*12%*	*3%*	*24%*	*14%*	*14%*	*7%*	*11%*
	City of Woodland	*7%*	*7%*	*7%*	*15%*	*5%*	*9%*	*6%*	*9%*	*7%*
	City of West Sacramento	*2%*	*2%*	*2%*	*3%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Winters	*1%*	*1%*	*1%*	*2%*	*0%*	*1%*	*1%*	*1%*	*1%*
	Other	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	Subtotal	83%	83%	83%	82%	84%	83%	80%	84%	82%
Sacramento Region (excluding Yolo Co.)[2]	*City of Sacramento*	*6%*	*6%*	*6%*	*6%*	*8%*	*7%*	*9%*	*5%*	*7%*
	City of Roseville	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*1%*	*0%*
	City of Elk Grove	*0%*	*1%*	*0%*	*1%*	*0%*	*1%*	*1%*	*1%*	*1%*
	City of Folsom	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	City of Rancho Cordova	*0%*	*0%*	*0%*	*0%*	*1%*	*0%*	*0%*	*0%*	*0%*
	Other	*3%*	*4%*	*3%*	*3%*	*2%*	*3%*	*3%*	*3%*	*3%*
	Subtotal	11%	11%	11%	11%	11%	11%	13%	10%	12%
Bay Area[3]	*City of Vacaville*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Fairfield	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*1%*	*0%*	*1%*
	City of San Francisco	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	City of San Jose	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	City of Dixon	*1%*	*1%*	*1%*	*3%*	*1%*	*2%*	*1%*	*2%*	*2%*
	Other	*2%*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*
	Subtotal	6%	6%	6%	7%	5%	6%	6%	6%	6%
San Joaquin Valley[4]	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%
Central Sierra Nevada[5]	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%
North Central Valley[6]	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: Trips represent vehicle trip ends. For example, a one-way trip has two trip ends (one origin and one destination). This approach allows for comparisons across internal and external trip types. Table only includes trip ends within the City of Davis. Estimates derived from StreetLight Data vehicle trip estimates for Fall 2019 (September through November 2019).

[1] Typical weekday represents aggregation of Tuesday, Wednesday, and Thursday trip data.

[2] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.

[3] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

[4] Includes San Joaquin, Stanislaus, and Merced Counties.

[5] Includes Amador, Calaveras, and Tuolumne Counties.

[6] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.

Sources: StreetLight Data, Fehr & Peers, 2021.

Worker Home-Work Location Patterns

This section presents the following worker home and work location data derived from the US Census Bureau LEHD program:

- Home location of workers who work in the City of Davis
- Work location of workers who live in the City of Davis

This data is presented between 2003 (the earliest complete dataset) and 2019 (the most recent complete dataset) to illustrate historic trends. This data can be aggregated to represent the following potential work commute trips:

- Internal-internal trips for workers who both live and work in Davis
- Internal-external trips for workers who live in Davis and work elsewhere
- External-internal trips for workers who live elsewhere and work in Davis

Note that for the purposes of this analysis, UC Davis is considered an external work location due to its location outside of the City of Davis city limits. However, given the interrelated nature of travel between the City of Davis and UC Davis, external trips associated with UC Davis are isolated from other external work locations as a separate line item.

Internal and External Location Trends

Table 5 summarizes the count and share of home and work locations for workers who either live or work in the City of Davis and aggregates this data by internal and external trip types (e.g., internal-external).

Home Location of Workers who Work in Davis

In 2019, 15,984 workers worked in the City of Davis, of which 27 percent resided within the City of Davis and 73 percent resided elsewhere. Comparatively, in 2003, 14,051 workers worked in the City of Davis, of which 38 percent resided within the City of Davis and 62 percent resided elsewhere. Between 2003 and 2019, the number of total workers who worked in the City of Davis increased by 1,933 workers (+14 percent), the number of workers who both lived and worked within the City of Davis decreased by 1,010 workers (-19 percent), and the number of workers who worked in the City of Davis and lived elsewhere increased by 2,943 workers (+34 percent).

Work Location of Workers who Live in Davis

In 2019, 24,819 workers lived in the City of Davis, of which 17 percent worked within the City of Davis, 15 percent worked at UC Davis, and 68 percent worked elsewhere. Comparatively, in 2003, 23,378 workers lived in the City of Davis, of which 23 percent worked within the City of Davis, 24 percent worked at UC Davis, and 53 percent worked elsewhere. Between 2003 and 2019, the number of total workers who lived in the City of Davis increased by 1,441 workers (+6 percent), the number of workers who both lived and worked within the City of Davis decreased by 1,010 workers (-19 percent), the number of workers who lived in Davis and worked at UC Davis decreased by 1,862 (-33 percent), and the number of workers who lived in the City of Davis and worked elsewhere increased by 4,313 workers (+35 percent).

Home-Work Location Trends

Tables 6 through 9 summarize the common home and work locations for workers who either live or work in the City of Davis. Tables 6 and 7 present this information for workers who work in the City of Davis by count and share, respectively. Tables 8 and 9 present this information for workers who live in the City of Davis by count and share, respectively.

Home Location of Workers who Work in Davis

As shown in Tables 6 and 7, in 2019, for workers who work in the City of Davis, the most common home locations (in descending order) were the City of Davis (4,291 workers, 27 percent), the City of Sacramento (1,685 workers, 11 percent), the City of Woodland (1,505 workers, 9 percent), the City of Vacaville (431 workers, 3 percent), the City of West Sacramento (423 workers, 3 percent), the City of Elk Grove (326 workers, 2 percent), and the City of Dixon (321 trips, 2 percent).

Places that exhibited the greatest increases in the number of worker home locations between 2003 and 2019 included the Sacramento Region (+1,275 workers, +45 percent), the City of Sacramento (+605 workers, +56 percent), the City of Woodland (+343 workers, +30 percent), the City of West Sacramento (+210 workers, +99 percent), the City of Elk Grove (+135 workers, +71 percent), and the City of Vacaville (+123 workers, +40 percent). Several places exhibited decreases in the number of worker home locations between 2003 and 2019, including the City of Davis (-1,010 workers, -19 percent), Yolo County (-445 workers, -6 percent), the City of San Francisco (-88 workers, -42 percent), the Bay Area (-67 workers, -3 percent), the City of Winters (-54 workers, -31 percent), and the City of Dixon (-19 workers, -6 percent).

Work Location of Workers who Live in Davis

As shown in Tables 8 and 9, in 2019, for workers who live in the City of Davis, the most common work locations (in descending order) were the City of Sacramento (4,370 workers, 18 percent), the City of Davis (4,291 workers, 17 percent), UC Davis (3,758 workers, 15 percent), the City of Woodland (1,033 workers, 4 percent), and the City of Vacaville (521 workers, 2 percent).

Places that exhibited the greatest increases in the number of worker work locations between 2003 and 2019 included the Sacramento Region (+1,980 workers, +36 percent), the City of Sacramento (+880 workers, +25 percent), the Bay Area (+874 workers, +29 percent), the City of San Francisco (+173 workers, +60 percent), the City of Elk Grove (+158 workers, +69 percent), and the City of Elk Grove (+124 workers, +108 percent). Several places exhibited decreases in the number of worker work locations between 2003 and 2019, including Yolo County (-2,884 workers, -23 percent), UC Davis (-1,862 workers, -33 percent), the City of Davis (-1,010 workers, -19 percent), and the City of Woodland (-99 workers, -9 percent).

Additionally, the ranking of the top 3 worker work locations changed from 2003 to 2019. In 2003, UC Davis ranked first, followed by the City of Davis, followed by the City of Sacramento. In 2019, the City of Sacramento ranked first, followed by the City of Davis, followed by UC Davis.

Home-Work Travel Distance Trends

Chart 1 and Table 10 summarize travel distances between home and work locations for workers who either live or work in the City of Davis. The data is presented separately in Chart 1 as outflows (solid lines) and inflows (dashed lines).

In 2019, approximately 8,000 workers lived less than five miles from work, effectively representing workers who lived in the City of Davis and worked either within the City of Davis or at UC Davis. This represents a decrease of approximately 2,900 workers (-26 percent) from 2003.

Nearly all other home-work travel distance categories experienced increases in the number of workers between 2003 and 2019. The largest increases included outflows between 15 and 25 miles (+1,122 workers, +28 percent), outflows between 60 and 120 miles (+1,065 workers, +50 percent), inflows between 15 and 25 miles (+815 workers, +49 percent), and outflows between 25 and 40 miles (+782 workers, +37 percent).

As shown in Table 10, the average worker home-work one-way travel distance increased from 23.9 to 29.3 miles between 2003 and 2019 (+5.4 miles, +22 percent).

Table 5: City of Davis Workers, Home and Work Locations, 2003 to 2019

Type/Location		Year																	Change 2003 to 2019	
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	#	%
Home Location of Workers who Work in Davis																				
Count	*Live in Davis, Work in Davis (Internal-Internal)*	*5,301*	*5,033*	*5,290*	*5,160*	*4,749*	*4,929*	*4,697*	*4,234*	*3,986*	*3,921*	*4,013*	*3,973*	*4,094*	*4,258*	*4,203*	*4,173*	*4,291*	*-1,010*	*-19%*
	Live Elsewhere, Work in Davis (External-Internal)	*8,750*	*9,211*	*8,940*	*9,218*	*9,826*	*9,823*	*9,478*	*9,978*	*10,023*	*10,022*	*10,154*	*10,569*	*9,967*	*10,590*	*10,994*	*11,434*	*11,693*	*2,943*	*34%*
	Total	**14,051**	**14,244**	**14,230**	**14,378**	**14,575**	**14,752**	**14,175**	**14,212**	**14,009**	**13,943**	**14,167**	**14,542**	**14,061**	**14,848**	**15,197**	**15,607**	**15,984**	**1,933**	**14%**
Share	*Live in Davis, Work in Davis (Internal-Internal)*	*38%*	*35%*	*37%*	*36%*	*33%*	*33%*	*33%*	*30%*	*28%*	*28%*	*28%*	*27%*	*29%*	*29%*	*28%*	*27%*	*27%*		
	Live Elsewhere, Work in Davis (External-Internal)	*62%*	*65%*	*63%*	*64%*	*67%*	*67%*	*67%*	*70%*	*72%*	*72%*	*72%*	*73%*	*71%*	*71%*	*72%*	*73%*	*73%*		
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		
Work Location of Workers who Live in Davis																				
Count	*Live in Davis, Work in Davis (Internal-Internal)*	*5,301*	*5,033*	*5,290*	*5,160*	*4,749*	*4,929*	*4,697*	*4,234*	*3,986*	*3,921*	*4,013*	*3,973*	*4,094*	*4,258*	*4,203*	*4,173*	*4,291*	*-1,010*	*-19%*
	Live in Davis, Work at UC Davis (Internal-External)	*5,620*	*5,750*	*5,749*	*5,527*	*5,159*	*5,473*	*5,655*	*4,585*	*4,034*	*3,909*	*3,718*	*3,759*	*4,226*	*4,045*	*3,675*	*3,465*	*3,758*	*-1,862*	*-33%*
	Live in Davis, Work Elsewhere (Internal-External)	*12,457*	*12,379*	*12,833*	*12,444*	*14,351*	*14,883*	*15,593*	*16,123*	*14,371*	*13,631*	*13,730*	*15,597*	*16,010*	*16,320*	*16,924*	*16,882*	*16,770*	*4,313*	*35%*
	Total	**23,378**	**23,162**	**23,872**	**23,131**	**24,259**	**25,285**	**25,945**	**24,942**	**22,391**	**21,461**	**21,461**	**23,329**	**24,330**	**24,623**	**24,802**	**24,520**	**24,819**	**1,441**	**6%**
Share	*Live in Davis, Work in Davis (Internal-Internal)*	*23%*	*22%*	*22%*	*22%*	*20%*	*19%*	*18%*	*17%*	*18%*	*18%*	*19%*	*17%*	*17%*	*17%*	*17%*	*17%*	*17%*		
	Live in Davis, Work at UC Davis (Internal-External)	*24%*	*25%*	*24%*	*24%*	*21%*	*22%*	*22%*	*18%*	*18%*	*18%*	*17%*	*16%*	*17%*	*16%*	*15%*	*14%*	*15%*		
	Live in Davis, Work Elsewhere (Internal-External)	*53%*	*53%*	*54%*	*54%*	*59%*	*59%*	*60%*	*65%*	*64%*	*64%*	*64%*	*67%*	*66%*	*66%*	*68%*	*69%*	*68%*		
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		

Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Table 6: Home Location of Workers Who Work in the City of Davis, 2003 to 2019, Count

Home Location		Year																	Change 2003 to 2019	
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	#	%
Yolo County	*City of Davis*	*5,301*	*5,033*	*5,290*	*5,160*	*4,749*	*4,929*	*4,697*	*4,234*	*3,986*	*3,921*	*4,013*	*3,973*	*4,094*	*4,258*	*4,203*	*4,173*	*4,291*	*-1,010*	*-19%*
	UC Davis	*76*	*54*	*55*	*52*	*44*	*57*	*26*	*36*	*37*	*36*	*21*	*26*	*23*	*20*	*28*	*46*	*47*	*-29*	*-38%*
	City of Woodland	*1,162*	*1,020*	*1,044*	*1,031*	*1,167*	*1,116*	*1,087*	*1,091*	*1,213*	*1,165*	*1,223*	*1,276*	*1,162*	*1,291*	*1,289*	*1,428*	*1,505*	*343*	*30%*
	City of West Sacramento	*213*	*165*	*162*	*173*	*361*	*338*	*234*	*345*	*403*	*429*	*435*	*485*	*437*	*416*	*466*	*468*	*423*	*210*	*99%*
	City of Winters	*176*	*164*	*144*	*155*	*162*	*161*	*124*	*119*	*136*	*124*	*129*	*116*	*118*	*125*	*119*	*140*	*122*	*-54*	*-31%*
	Other	*26*	*38*	*30*	*35*	*50*	*56*	*35*	*77*	*110*	*96*	*113*	*112*	*91*	*109*	*95*	*92*	*121*	*95*	*365%*
	Subtotal	6,954	6,474	6,725	6,606	6,533	6,657	6,203	5,902	5,885	5,771	5,934	5,988	5,925	6,219	6,200	6,347	6,509	-445	-6%
Sacramento Region (excluding Yolo Co.)[1]	*City of Sacramento*	*1,080*	*1,164*	*1,130*	*1,191*	*1,185*	*1,131*	*1,157*	*1,161*	*1,355*	*1,374*	*1,393*	*1,355*	*1,392*	*1,443*	*1,572*	*1,587*	*1,685*	*605*	*56%*
	Arden-Arcade CDP	*147*	*171*	*148*	*176*	*157*	*160*	*163*	*144*	*163*	*162*	*167*	*149*	*149*	*145*	*162*	*173*	*155*	*8*	*5%*
	City of Roseville	*130*	*149*	*145*	*103*	*141*	*138*	*188*	*173*	*164*	*170*	*151*	*144*	*149*	*141*	*137*	*146*	*159*	*29*	*22%*
	City of Elk Grove	*191*	*208*	*244*	*215*	*238*	*244*	*241*	*246*	*335*	*319*	*301*	*282*	*329*	*304*	*329*	*371*	*326*	*135*	*71%*
	City of Folsom	*55*	*79*	*82*	*76*	*82*	*85*	*89*	*77*	*113*	*76*	*78*	*98*	*77*	*94*	*76*	*103*	*98*	*43*	*78%*
	City of Rancho Cordova	*88*	*94*	*70*	*78*	*101*	*121*	*100*	*119*	*79*	*116*	*101*	*102*	*127*	*120*	*138*	*148*	*123*	*35*	*40%*
	Other	*1,146*	*1,270*	*1,197*	*1,267*	*1,500*	*1,498*	*1,446*	*1,598*	*1,563*	*1,555*	*1,468*	*1,542*	*1,416*	*1,488*	*1,475*	*1,495*	*1,566*	*420*	*37%*
	Subtotal	2,837	3,135	3,016	3,106	3,404	3,377	3,384	3,518	3,772	3,772	3,659	3,672	3,639	3,735	3,889	4,023	4,112	1,275	45%
Bay Area[2]	*City of Vacaville*	*308*	*327*	*292*	*322*	*372*	*346*	*306*	*382*	*398*	*380*	*386*	*406*	*396*	*393*	*406*	*412*	*431*	*123*	*40%*
	City of Fairfield	*76*	*87*	*112*	*85*	*95*	*114*	*107*	*111*	*114*	*119*	*129*	*131*	*123*	*154*	*139*	*134*	*177*	*101*	*133%*
	City of San Francisco	*209*	*248*	*232*	*215*	*176*	*190*	*156*	*155*	*103*	*96*	*133*	*152*	*162*	*157*	*163*	*149*	*121*	*-88*	*-42%*
	City of San Jose	*141*	*182*	*168*	*164*	*152*	*160*	*160*	*143*	*181*	*149*	*146*	*151*	*150*	*175*	*164*	*151*	*160*	*19*	*13%*
	City of Dixon	*340*	*308*	*316*	*373*	*341*	*357*	*357*	*271*	*299*	*299*	*332*	*348*	*324*	*335*	*339*	*339*	*321*	*-19*	*-6%*
	Other	*1,230*	*1,489*	*1,322*	*1,361*	*1,067*	*1,036*	*1,061*	*921*	*735*	*746*	*846*	*900*	*858*	*916*	*963*	*1,005*	*1,027*	*-203*	*-17%*
	Subtotal	2,304	2,641	2,442	2,520	2,203	2,203	2,147	1,983	1,830	1,789	1,972	2,088	2,013	2,130	2,174	2,190	2,237	-67	-3%
San Joaquin Valley[3]	Subtotal	333	318	341	339	408	390	360	401	327	340	332	386	369	413	418	487	532	199	60%
Central Sierra Nevada[4]	Subtotal	20	26	19	20	17	21	25	35	57	66	58	75	56	69	65	56	74	54	270%
North Central Valley[5]	Subtotal	100	101	111	101	98	128	127	115	173	145	118	177	118	127	138	143	160	60	60%
Other	Subtotal	1,503	1,549	1,576	1,686	1,912	1,976	1,929	2,258	1,965	2,060	2,094	2,156	1,941	2,155	2,313	2,361	2,360	857	57%
	Total	**14,051**	**14,244**	**14,230**	**14,378**	**14,575**	**14,752**	**14,175**	**14,212**	**14,009**	**13,943**	**14,167**	**14,542**	**14,061**	**14,848**	**15,197**	**15,607**	**15,984**	**1,933**	**14%**

Notes: [1] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.
[2] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.
[3] Includes San Joaquin, Stanislaus, and Merced Counties.
[4] Includes Amador, Calaveras, and Tuolumne Counties.
[5] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.
Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Table 7: Home Location of Workers Who Work in the City of Davis, 2003 to 2019, Share

Home Location		Year																
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Yolo County	*City of Davis*	*38%*	*35%*	*37%*	*36%*	*33%*	*33%*	*33%*	*30%*	*28%*	*28%*	*28%*	*27%*	*29%*	*29%*	*28%*	*27%*	*27%*
	UC Davis	*1%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	City of Woodland	*8%*	*7%*	*7%*	*7%*	*8%*	*8%*	*8%*	*8%*	*9%*	*8%*	*9%*	*9%*	*8%*	*9%*	*8%*	*9%*	*9%*
	City of West Sacramento	*2%*	*1%*	*1%*	*1%*	*2%*	*2%*	*2%*	*2%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*
	City of Winters	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	Other	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	Subtotal	49%	45%	47%	46%	45%	45%	44%	42%	42%	41%	42%	41%	42%	42%	41%	41%	41%
Sacramento Region (excluding Yolo Co.)[1]	*City of Sacramento*	*8%*	*8%*	*8%*	*8%*	*8%*	*8%*	*8%*	*8%*	*10%*	*10%*	*10%*	*9%*	*10%*	*10%*	*10%*	*10%*	*11%*
	Arden-Arcade CDP	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Roseville	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Elk Grove	*1%*	*1%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Folsom	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Rancho Cordova	*1%*	*1%*	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	Other	*8%*	*9%*	*8%*	*9%*	*10%*	*10%*	*10%*	*11%*	*11%*	*11%*	*10%*	*11%*	*10%*	*10%*	*10%*	*10%*	*10%*
	Subtotal	20%	22%	21%	22%	23%	23%	24%	25%	27%	27%	26%	25%	26%	25%	26%	26%	26%
Bay Area[2]	*City of Vacaville*	*2%*	*2%*	*2%*	*2%*	*3%*	*2%*	*2%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*
	City of Fairfield	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of San Francisco	*1%*	*2%*	*2%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of San Jose	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Dixon	*2%*	*2%*	*2%*	*3%*	*2%*	*2%*	*3%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	Other	*9%*	*10%*	*9%*	*9%*	*7%*	*7%*	*7%*	*6%*	*5%*	*5%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*
	Subtotal	16%	19%	17%	18%	15%	15%	15%	14%	13%	13%	14%	14%	14%	14%	14%	14%	14%
San Joaquin Valley[3]	Subtotal	2%	2%	2%	2%	3%	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Central Sierra Nevada[4]	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
North Central Valley[5]	Subtotal	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Other	Subtotal	11%	11%	11%	12%	13%	13%	14%	16%	14%	15%	15%	15%	14%	15%	15%	15%	15%
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: [1] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.
[2] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.
[3] Includes San Joaquin, Stanislaus, and Merced Counties.
[4] Includes Amador, Calaveras, and Tuolumne Counties.
[5] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.
Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Table 8: Work Location of Workers Who Live in the City of Davis, 2003 to 2019, Count

Work Location		Year																	Change 2003 to 2019	
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	#	%
Yolo County	*City of Davis*	*5,301*	*5,033*	*5,290*	*5,160*	*4,749*	*4,929*	*4,697*	*4,234*	*3,986*	*3,921*	*4,013*	*3,973*	*4,094*	*4,258*	*4,203*	*4,173*	*4,291*	*-1,010*	*-19%*
	UC Davis	*5,620*	*5,750*	*5,749*	*5,527*	*5,159*	*5,473*	*5,655*	*4,585*	*4,034*	*3,909*	*3,718*	*3,759*	*4,226*	*4,045*	*3,675*	*3,465*	*3,758*	*-1,862*	*-33%*
	City of Woodland	*1,132*	*1,104*	*1,117*	*1,078*	*1,147*	*1,153*	*1,135*	*1,040*	*952*	*874*	*787*	*820*	*1,005*	*1,020*	*973*	*1,052*	*1,033*	*-99*	*-9%*
	City of West Sacramento	*324*	*391*	*367*	*401*	*411*	*402*	*494*	*367*	*344*	*326*	*347*	*346*	*475*	*421*	*414*	*392*	*429*	*105*	*32%*
	City of Winters	*107*	*101*	*103*	*124*	*97*	*113*	*86*	*84*	*68*	*64*	*68*	*59*	*77*	*78*	*89*	*81*	*81*	*-26*	*-24%*
	Other	*17*	*25*	*30*	*22*	*24*	*22*	*23*	*34*	*16*	*13*	*21*	*24*	*34*	*27*	*19*	*27*	*25*	*8*	*47%*
	Subtotal	12,501	12,404	12,656	12,312	11,587	12,092	12,090	10,344	9,400	9,107	8,954	8,981	9,911	9,849	9,373	9,190	9,617	-2,884	-23%
Sacramento Region (excluding Yolo Co.)[1]	*City of Sacramento*	*3,490*	*3,416*	*3,514*	*3,402*	*3,489*	*3,632*	*4,262*	*4,766*	*4,732*	*4,504*	*4,448*	*4,554*	*4,613*	*4,449*	*4,683*	*4,598*	*4,370*	*880*	*25%*
	Arden-Arcade CDP	*374*	*370*	*383*	*366*	*414*	*417*	*411*	*393*	*389*	*376*	*391*	*391*	*429*	*398*	*380*	*374*	*432*	*58*	*16%*
	City of Roseville	*230*	*230*	*230*	*223*	*394*	*284*	*362*	*306*	*350*	*352*	*366*	*381*	*353*	*437*	*443*	*401*	*388*	*158*	*69%*
	City of Elk Grove	*115*	*115*	*135*	*113*	*167*	*196*	*179*	*169*	*205*	*179*	*200*	*191*	*229*	*242*	*261*	*263*	*239*	*124*	*108%*
	City of Folsom	*118*	*130*	*173*	*124*	*196*	*218*	*224*	*207*	*191*	*141*	*180*	*175*	*194*	*234*	*241*	*231*	*235*	*117*	*99%*
	City of Rancho Cordova	*285*	*283*	*302*	*252*	*334*	*313*	*362*	*327*	*336*	*315*	*306*	*262*	*293*	*331*	*317*	*320*	*349*	*64*	*22%*
	Other	*948*	*915*	*950*	*913*	*1,267*	*1,338*	*1,227*	*1,294*	*1,415*	*1,306*	*1,371*	*1,455*	*1,375*	*1,481*	*1,552*	*1,478*	*1,527*	*579*	*61%*
	Subtotal	5,560	5,459	5,687	5,393	6,261	6,398	7,027	7,462	7,618	7,173	7,262	7,409	7,486	7,572	7,877	7,665	7,540	1,980	36%
Bay Area[2]	*City of Vacaville*	*422*	*373*	*405*	*314*	*369*	*494*	*518*	*451*	*426*	*426*	*450*	*458*	*503*	*537*	*539*	*529*	*521*	*99*	*23%*
	City of Fairfield	*424*	*421*	*383*	*344*	*424*	*457*	*481*	*424*	*435*	*380*	*374*	*345*	*432*	*464*	*458*	*426*	*411*	*-13*	*-3%*
	City of San Francisco	*287*	*218*	*214*	*227*	*309*	*311*	*377*	*408*	*178*	*158*	*175*	*464*	*426*	*426*	*426*	*440*	*460*	*173*	*60%*
	City of San Jose	*183*	*132*	*155*	*153*	*183*	*187*	*202*	*204*	*78*	*97*	*90*	*188*	*211*	*192*	*210*	*217*	*230*	*47*	*26%*
	City of Dixon	*289*	*317*	*313*	*322*	*246*	*256*	*268*	*177*	*217*	*185*	*201*	*227*	*232*	*191*	*180*	*192*	*191*	*-98*	*-34%*
	Other	*1,374*	*1,495*	*1,560*	*1,582*	*1,975*	*1,889*	*1,807*	*1,856*	*1,364*	*1,363*	*1,229*	*1,799*	*1,868*	*1,887*	*1,989*	*1,985*	*2,040*	*666*	*48%*
	Subtotal	2,979	2,956	3,030	2,942	3,506	3,594	3,653	3,520	2,698	2,609	2,519	3,481	3,672	3,697	3,802	3,789	3,853	874	29%
San Joaquin Valley[3]	Subtotal	449	435	488	503	533	551	523	616	448	425	423	570	594	593	649	687	671	222	49%
Central Sierra Nevada[4]	Subtotal	11	12	11	10	7	6	2	12	55	52	53	39	17	19	23	23	25	14	127%
North Central Valley[5]	Subtotal	148	171	152	154	143	115	131	157	155	169	159	164	130	168	167	188	204	56	38%
Other	Subtotal	1,730	1,725	1,848	1,817	2,222	2,529	2,519	2,831	2,017	1,926	2,091	2,685	2,520	2,725	2,911	2,978	2,909	1,179	68%
	Total	**23,378**	**23,162**	**23,872**	**23,131**	**24,259**	**25,285**	**25,945**	**24,942**	**22,391**	**21,461**	**21,461**	**23,329**	**24,330**	**24,623**	**24,802**	**24,520**	**24,819**	**1,441**	**6%**

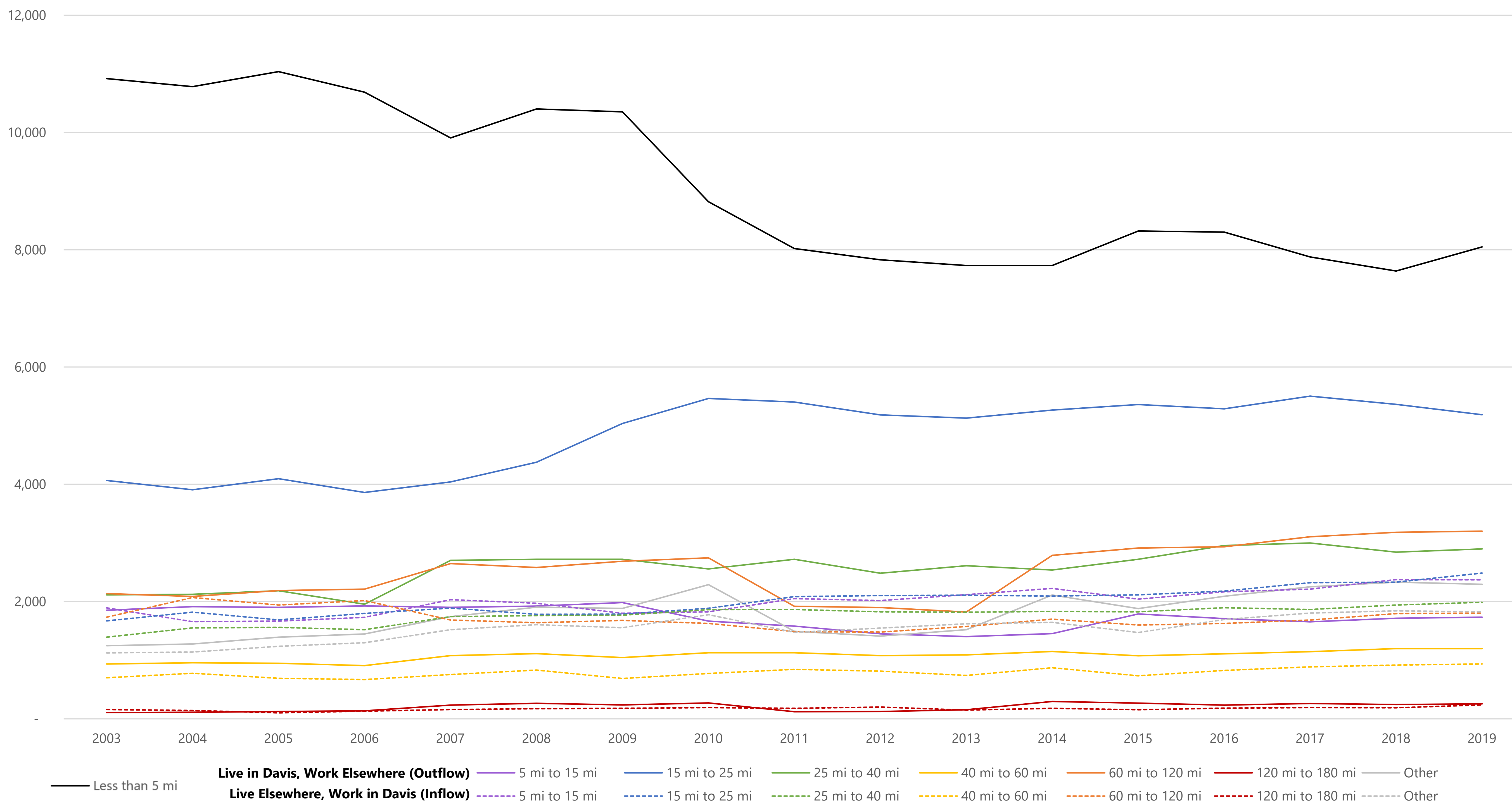
Notes: [1] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.
[2] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.
[3] Includes San Joaquin, Stanislaus, and Merced Counties.
[4] Includes Amador, Calaveras, and Tuolumne Counties.
[5] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.
Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Table 9: Work Location of Workers Who Live in the City of Davis, 2003 to 2019, Share

Work Location		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Yolo County	*City of Davis*	*23%*	*22%*	*22%*	*22%*	*20%*	*19%*	*18%*	*17%*	*18%*	*18%*	*19%*	*17%*	*17%*	*17%*	*17%*	*17%*	*17%*
	UC Davis	*24%*	*25%*	*24%*	*24%*	*21%*	*22%*	*22%*	*18%*	*18%*	*18%*	*17%*	*16%*	*17%*	*16%*	*15%*	*14%*	*15%*
	City of Woodland	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*
	City of West Sacramento	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Winters	*0%*	*0%*	*0%*	*1%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	Other	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
	Subtotal	53%	54%	53%	53%	48%	48%	47%	41%	42%	42%	42%	38%	41%	40%	38%	37%	39%
Sacramento Region (excluding Yolo Co.)[1]	*City of Sacramento*	*15%*	*15%*	*15%*	*15%*	*14%*	*14%*	*16%*	*19%*	*21%*	*21%*	*21%*	*20%*	*19%*	*18%*	*19%*	*19%*	*18%*
	Arden-Arcade CDP	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Roseville	*1%*	*1%*	*1%*	*1%*	*2%*	*1%*	*1%*	*1%*	*2%*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*
	City of Elk Grove	*0%*	*0%*	*1%*	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Folsom	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Rancho Cordova	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*2%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	Other	*4%*	*4%*	*4%*	*4%*	*5%*	*5%*	*5%*	*5%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*	*6%*
	Subtotal	24%	24%	24%	23%	26%	25%	27%	30%	34%	33%	34%	32%	31%	31%	32%	31%	30%
Bay Area[2]	*City of Vacaville*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of Fairfield	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of San Francisco	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*2%*	*1%*	*1%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
	City of San Jose	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*0%*	*0%*	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	City of Dixon	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
	Other	*6%*	*6%*	*7%*	*7%*	*8%*	*7%*	*7%*	*7%*	*6%*	*6%*	*6%*	*8%*	*8%*	*8%*	*8%*	*8%*	*8%*
	Subtotal	13%	13%	13%	13%	14%	14%	14%	14%	12%	12%	12%	15%	15%	15%	15%	15%	16%
San Joaquin Valley[3]	Subtotal	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	3%
Central Sierra Nevada[4]	Subtotal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
North Central Valley[5]	Subtotal	1%	1%	1%	1%	1%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Other	Subtotal	7%	7%	8%	8%	9%	10%	10%	11%	9%	9%	10%	12%	10%	11%	12%	12%	12%
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: [1] Includes Sacramento, Placer, El Dorado, Sutter, and Yuba Counties.
[2] Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.
[3] Includes San Joaquin, Stanislaus, and Merced Counties.
[4] Includes Amador, Calaveras, and Tuolumne Counties.
[5] Includes Butte, Colusa, Glenn, Lake, Tehama Counties.
Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Chart 1: City of Davis, Worker Home-Work Travel Distance, 2003 to 2019, Count



Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Table 10: City of Davis, Worker Home-Work Travel Distance, 2003 to 2019

Trip Type/Distance		2003	2019	Change 2003 to 2019	
				#	%
Live in Davis, Work in Davis/at UC Davis					
Less than 5 mi.	*Davis to Davis*	*5,301*	*4,291*	*-1,010*	*-19%*
	Davis to UC Davis	*5,620*	*3,758*	*-1,862*	*-33%*
	Subtotal	10,921	8,049	-2,872	-26%
Live in Davis, Work Elsewhere (Outflow)					
	5 to 15 mi.	*1,852*	*1,734*	*-118*	*-6%*
	15 to 25 mi.	*4,066*	*5,188*	*1,122*	*28%*
	25 to 40 mi.	*2,116*	*2,898*	*782*	*37%*
	40 to 60 mi.	*934*	*1,198*	*264*	*28%*
	60 to 120 mi.	*2,136*	*3,201*	*1,065*	*50%*
	120 to 180 mi.	*106*	*256*	*150*	*142%*
	Other	*1,247*	*2,295*	*1,048*	*84%*
	Subtotal	12,457	16,770	4,313	35%
Live Elsewhere, Work in Davis (Inflow)					
	5 to 15 mi.	*1,891*	*2,371*	*480*	*25%*
	15 to 25 mi.	*1,671*	*2,486*	*815*	*49%*
	25 to 40 mi.	*1,393*	*1,988*	*595*	*43%*
	40 to 60 mi.	*702*	*936*	*234*	*33%*
	60 to 120 mi.	*1,735*	*1,803*	*68*	*4%*
	120 to 180 mi.	*157*	*237*	*80*	*51%*
	Other	*1,125*	*1,825*	*700*	*62%*
	Subtotal	8,674	11,646	2,972	34%
All Workers					
	Less than 5 mi.	***10,921***	***8,049***	***-2,872***	***-26%***
	5 to 15 mi.	***3,743***	***4,105***	***362***	***10%***
	15 to 25 mi.	***5,737***	***7,674***	***1,937***	***34%***
	25 to 40 mi.	***3,509***	***4,886***	***1,377***	***39%***
	40 to 60 mi.	***1,636***	***2,134***	***498***	***30%***
	60 to 120 mi.	***3,871***	***5,004***	***1,133***	***29%***
	120 to 180 mi.	***263***	***493***	***230***	***87%***
	Other	***2,372***	***4,120***	***1,748***	***74%***
	Total	**32,052**	**36,465**	**4,413**	**14%**
Average Worker Home-Work One-Way Travel Distance (Miles)					
	Travel Distance	23.9	29.3	5.4	22%

Sources: US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.

Summary

As it relates to the CAAP, the following conclusions can be drawn from this analysis:

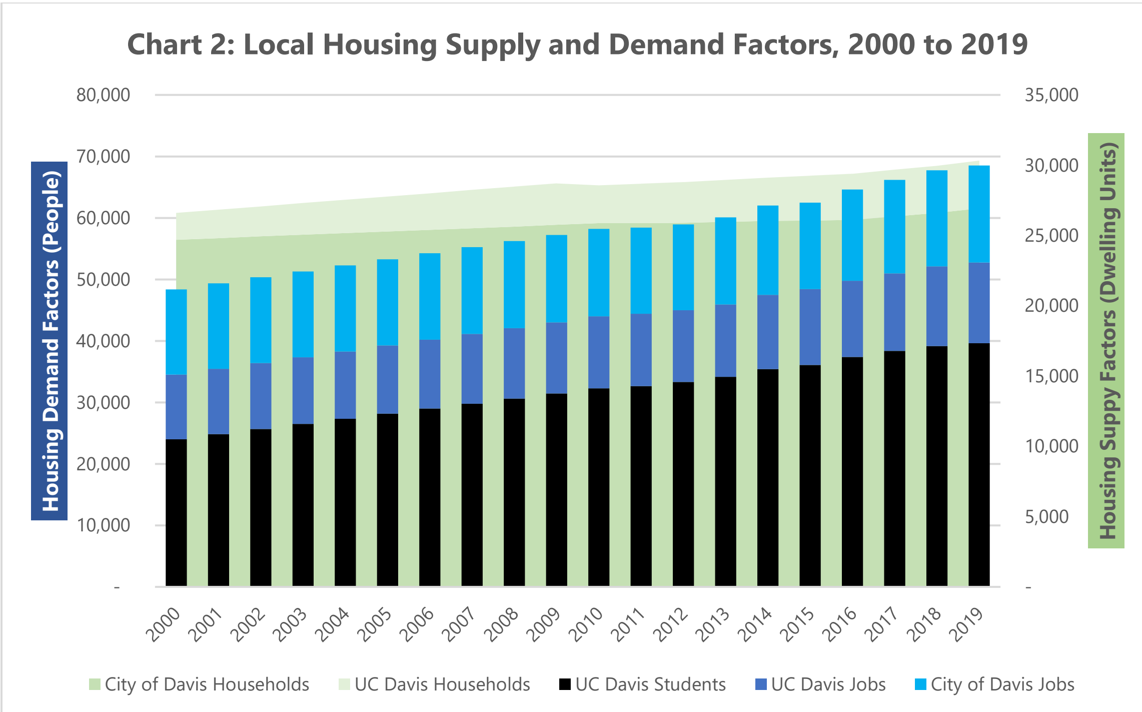
- On a daily basis, the majority of vehicle trips (approximately 62 percent) generated by the City of Davis remain internal to the City of Davis. An additional 12 percent of trips generated by the City of Davis travel to or from the immediately adjacent UC Davis campus. Given the extensive local active transportation and transit networks and relatively short travel distances, there is an opportunity to shift a portion of these trips to non-motorized modes, in turn reducing vehicle miles traveled (VMT) and associated greenhouse gas emissions generated by the City.
- The remaining 26 percent of vehicle trips generated by the City of Davis travel to or from locations outside of the City. While these trips represent a minority of overall vehicle trips generated by the City, they represent a substantial portion of the overall VMT and GHG emissions generated by the City. This is due to the physical separation between the City of Davis and other jurisdictions, which requires that external vehicle trips travel relatively long distances. This in turn yields a high VMT per trip relative to a trip that remains internal to Davis and travels a shorter distance. There is an opportunity for the City to reduce GHG emissions associated with these external trips through strategies such as partnerships/investments in regional transit connections with major external trip generators as well as land use decisions that strive to co-locate trip origins and destinations and internalize more travel demand within Davis.
- Compared to the early 2000s, City of Davis-based workers live further from where they work and are less likely to both live and work locally. Between 2003 and 2019, the number of workers who both live and work locally (including UC Davis) decreased from 10,921 to 8,049 workers (-2,872 workers, -26 percent) while the number of City of Davis-based workers who live or work outside of Davis increased from 21,207 to 28,463 workers (+7,256 workers, +34 percent). This represents a net increase of up to 4,384 workers commuting in and out of the City of Davis every day since 2003 (not accounting for remote work, mode split, etc.). Moreover, since 2003, the average one-way travel distance between home and work for City of Davis-based workers has increased from 23.9 to 29.3 miles (+5.4 miles, +22 percent). Altogether, these trends coincide with higher levels of City-generated VMT and GHG emissions due to the higher automobile mode share and travel distances associated with external commute trips.

The causes behind these trends are complex and require more detailed study. However, it is likely that local housing supply and demand factors play a role since these factors influence where people can choose to live relative to their workplace. In the case of Davis, local housing supply and demand factors are linked between the City and UC Davis given their close proximity. Moreover, local housing demand factors are driven not only by City of Davis and UC Davis employees but also UC Davis students who are likely to search for housing locally either on-campus or off-campus in Davis to be close to campus.

Chart 2 illustrates local housing supply and demand factors for the City of Davis and UC Davis between 2000 and 2019. Housing supply factors include dwelling units within the City of Davis and student beds on the UC Davis campus (for the purposes of this analysis, student beds are represented as dwelling unit equivalents at a rate of 3 beds/dwelling unit). Housing demand factors include City of Davis jobs (i.e., workers who work within the City of Davis), UC Davis jobs, and UC Davis students. These groups were selected because they represent the people who are likely to be physically present locally during a typical day, and thus the people who are most likely to seek out local housing opportunities that are close to work or school.

As shown in Chart 2, local housing demand factors increased from 48,260 to 68,526 people (+20,166 people, +42 percent) while local housing supply factors increased from 26,600 to 30,327 dwelling units (+3,727 dwelling units, +14 percent) between 2000 and 2019. As such, changes to local demand supply factors outpaced changes to local housing supply factors during this timeframe.

This data could help to explain the City of Davis-based worker home-work location trends described previously, as local workers could have been more likely to seek out housing opportunities elsewhere as the local housing supply became increasingly constrained. As described on the previous page, as it relates to the CAAP, there is an opportunity for the City to reduce GHG emissions associated with these trends through land use decisions that strive to co-locate trip origins and destinations and internalize more travel demand within Davis (e.g., modifying the local jobs-housing mix to align local housing supply and demand factors).



Note: UC Davis dwelling unit estimates assume 3 student beds/unit. This rate is based on US Census American Community Survey housing occupancy data for the City of Davis.

Sources: California Department of Finance Table E-5, UC Davis AggieData (Fall Quarter Student Enrollment), UC Davis 2003 Long Range Development Plan, UC Davis 2018 Long Range Development Plan, US Census Bureau American Community Survey 5-Year Estimates, US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Program, Fehr & Peers, 2021.