BEFORE THE PUBLIC UTILITIES COMMISSION OF NEVADA

Joint Application of Nevada Power Company d/b/a NV Energy and Sierra Pacific Power Company d/b/a NV Energy for approval of their joint 2025-2044 integrated resource plan, for the three year Action Plan period 2025-2027, and the Energy Supply Plan period of 2025-2027.	Docket No. 24-05___

VOLUME 7 OF 29

NEVADA POWER COMPANY D/B/A NV ENERGY AND
SIERRA PACIFIC POWER COMPANY D/B/A NV ENERGY

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LF-7

Commercial Statistically Adjusted End-Use (SAE) Spreadsheets – 2023 AEO Update

The 2023 Commercial Statistically Adjusted End-Use (SAE) spreadsheets and models have been updated to reflect the Energy Information Administration's (EIA) 2023 Annual Energy Outlook (AEO). All comparisons within this document compare the 2023 forecast with the 2022 forecast unless stated otherwise. Elements that have been updated include:

- End-use energy intensity projections
- End-use efficiency projections
- Floor stock projections
- Census Division commercial SAE project files (MetrixND)
- Revised historical saturations and efficiencies

The 2023 Commercial Statistically Adjusted End-Use (SAE) spreadsheets and the Energy Information Administration's (EIA) 2023 Annual Energy Outlook (AEO) include impacts of the Inflation Reduction Act (IRA).

Each year, EIA develops a long-term electric and gas forecast for the commercial sector using an end-use modeling framework that is part of the National Energy Modeling System (NEMS). EIA develops forecasts for 11 commercial building types, 9 electric end-uses and 5 natural gas end-uses. The largest electric end-uses include lighting, cooling, ventilation, refrigeration, and miscellaneous use. The largest gas end-use is heating, followed by water heating and cooking.

End-use intensity projections are key inputs in the commercial SAE forecast model. Commercial electrical end-use intensities are measured on a kWh per square foot basis and natural gas end-uses on a therms per square foot basis. Other than miscellaneous use, end-use intensities have been declining over the last 10 years and are expected to continue to decline over the next 20 years. The decline in energy intensities are largely driven by end-use efficiency improvements. Factors driving efficiency improvements include new building and end-use standards, the availability of more efficient technology options, declining costs for high-efficient technologies and federal, state utility efficiency programs, including efficiency investments through the Inflation Reduction Act.

Commercial Buildings Energy Consumption Survey (CBECS)

The Commercial Buildings Energy Consumption Survey (CBECS) is the foundation for the EIA commercial forecast model. End-use detail derived from the survey is used in defining the forecast base year. The 2023 AEO is based on the 2012 Commercial Buildings Energy Consumption Survey (CBECS) with a forecast base year of 2013. Prior to 2017 the AEO base year was 2004 with base year data derived from the 2003 CBECS. The most recent CBECS was completed in 2018. Data from the 2018 CBECS is being released in 2023 and will be incorporated in subsequent AEO and SAE releases.

Electric Forecast Updates

The EIA forecast model generates end-use consumption projections starting in the base year through 2050. Annual energy projections incorporate technology efficiency projections, equipment stock and factors that drive changes in equipment stock including available technologies and associated costs, energy prices and economic conditions. Commercial electric intensities are calculated for:

- Heating
- Cooling
- Ventilation
- Water Heating
- Cooking
- Refrigeration
- Lighting
- Office Equipment (PCs)
- Miscellaneous

End-use consumption and floor space by building type are downloaded from the EIA NEMS forecast output. Data is used to generate end-use intensities for 11 building types and 9 Census Divisions. The energy intensity (EI) is derived by dividing end-use energy consumption by square footage projections:

$$EI_{bet} = {Energy_{bet}}/{sqft_{bt}}$$

Where:

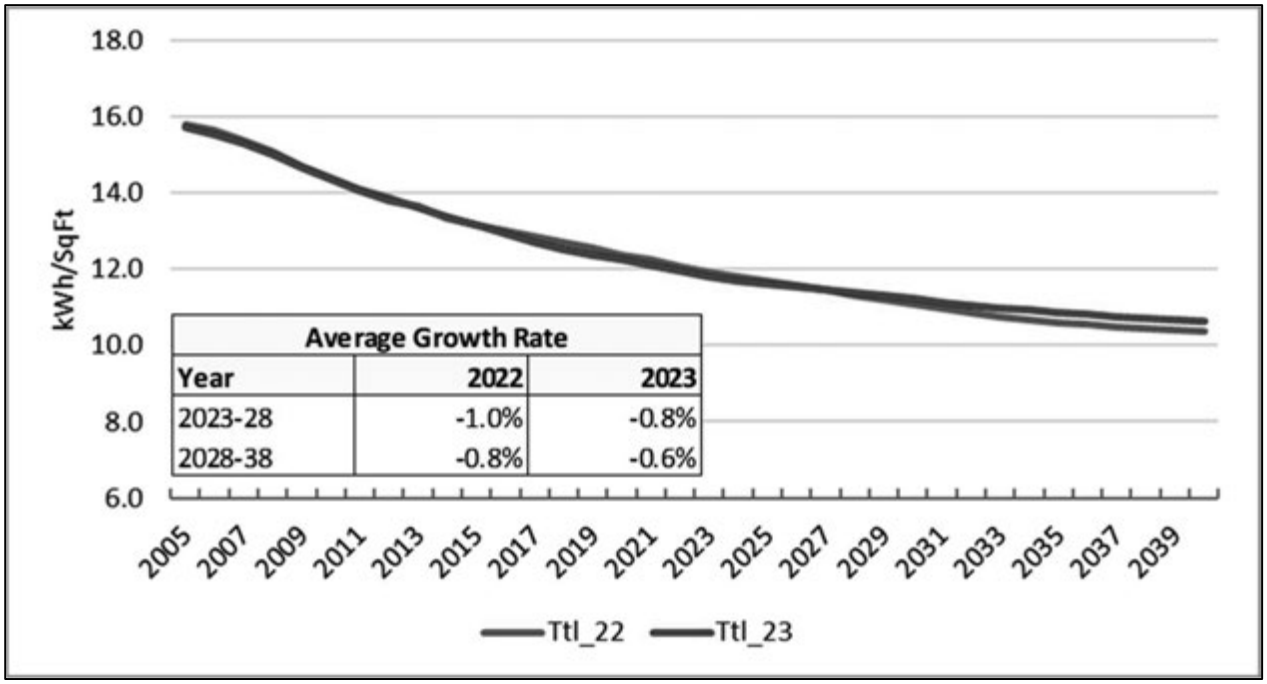
- $Energy_{bet}$ = Energy consumption for end-use e, building type *b*, year *t*
- $Sqft_{bt}$ = Square footage for building type *b* in year *t*

Total end-use energy intensities (across building types) are calculated as a weighted average of the building type intensities where the weights are based on building type square footage:

$$EI_{et} = \sum_b EI_{bet} \times \left({sqft_{bt}}/{\sum_b sqft_{bt}}\right)$$

At the U.S. level, EIA projects a 0.8% annual decline in energy intensity between 2023 and 2028, this is a small decrease from the 1.0% decline projected in the AEO 2022 forecast. Over the longer term, the current forecast declines slightly slower than the prior forecast at 0.6% annual rate vs 0.8% annual rate. **Figure 1** compares total commercial electric intensity projections.

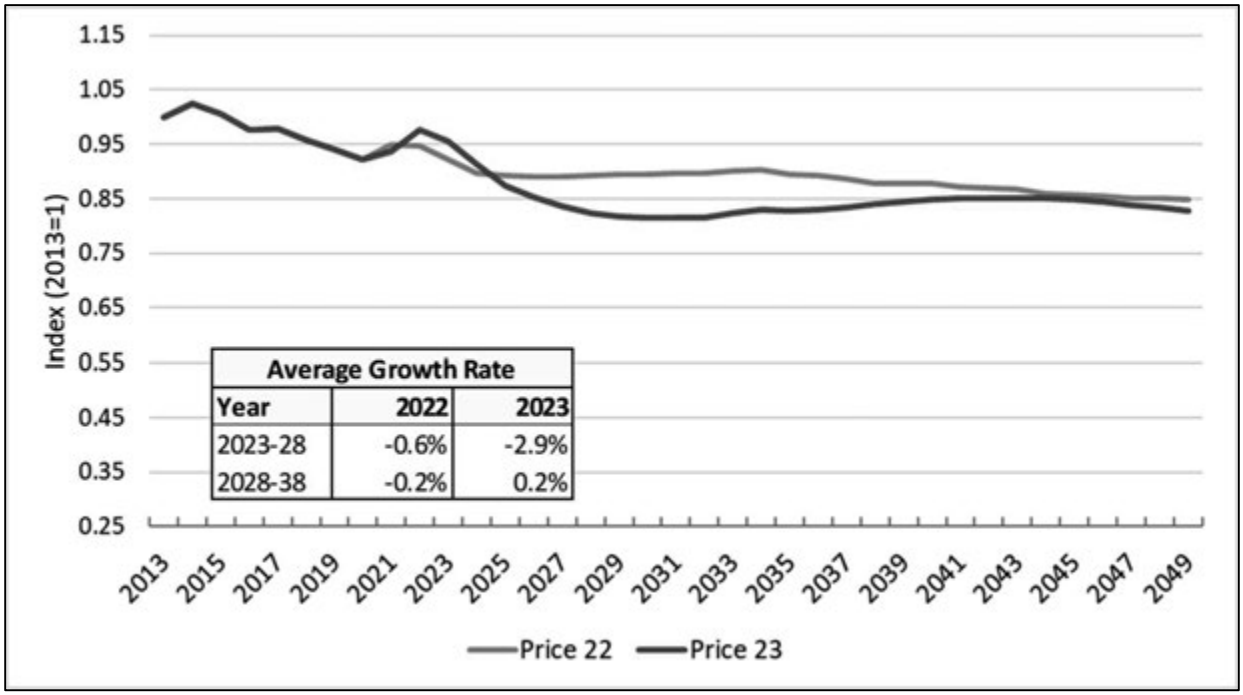
Figure 1: Total Commercial Building Electricity Intensity (kWh/SqFt)



Average Growth Rate		
Year	2022	2023
2023-28	-1.0%	-0.8%
2028-38	-0.8%	-0.6%

In addition to technology options and equipment costs, energy prices are also a key factor in driving equipment efficiency choices and utilization. There have been revisions to the near-term price projections, with 2022 and 2023 prices being significantly higher than what was forecasted in the 2022 AEO. Start at a higher level, the 2023 AEO price forecast declines faster from 2023-2028, compared to the 2022 AEO price forecast. **Figure 2** compares AEO 2022 and 2023 commercial price projections.

Figure 2: Commercial Electric Prices (Index)

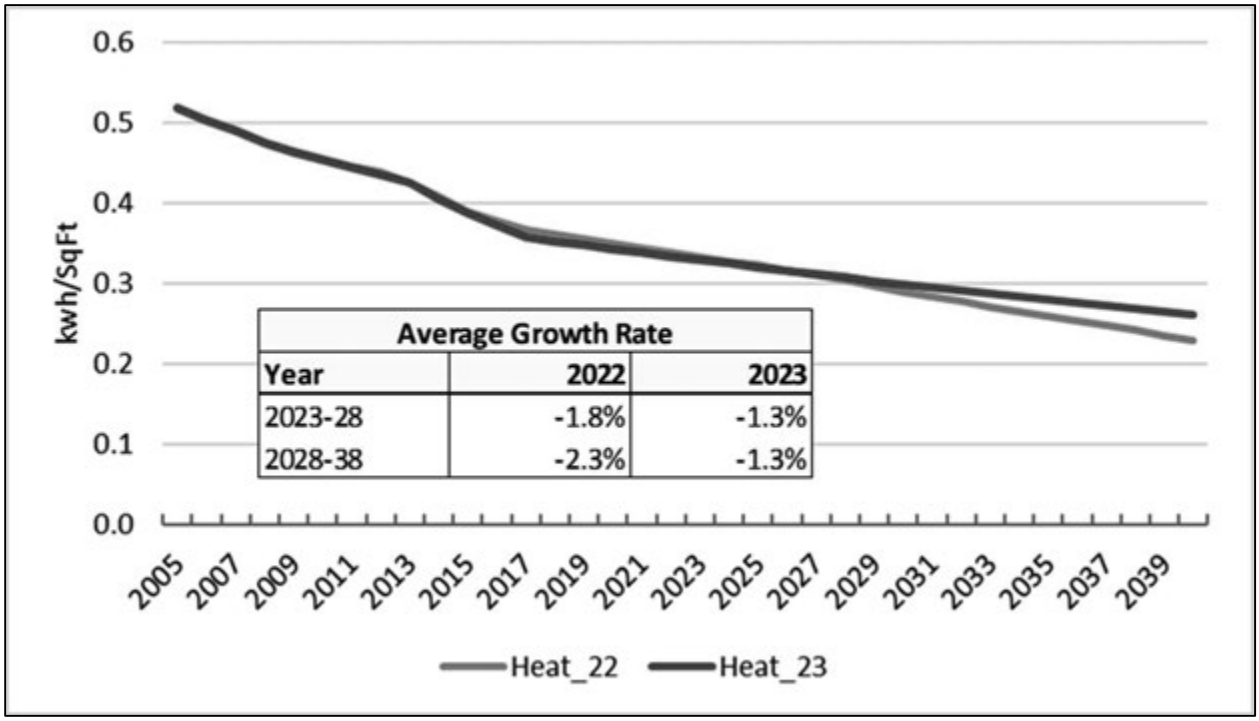


Average Growth Rate		
Year	2022	2023
2023-28	-0.6%	-2.9%
2028-38	-0.2%	0.2%

Electric Heating

Although electric heating is a relatively small end use, heating intensity projections contribute to the overall decline in commercial building usage. Electric heating intensity declines 1.3% over the forecast period. The change from the 2022 AEO is based on revised efficiency assumptions. **Figure 3** compares the 2022 and 2023 heating intensity forecasts.

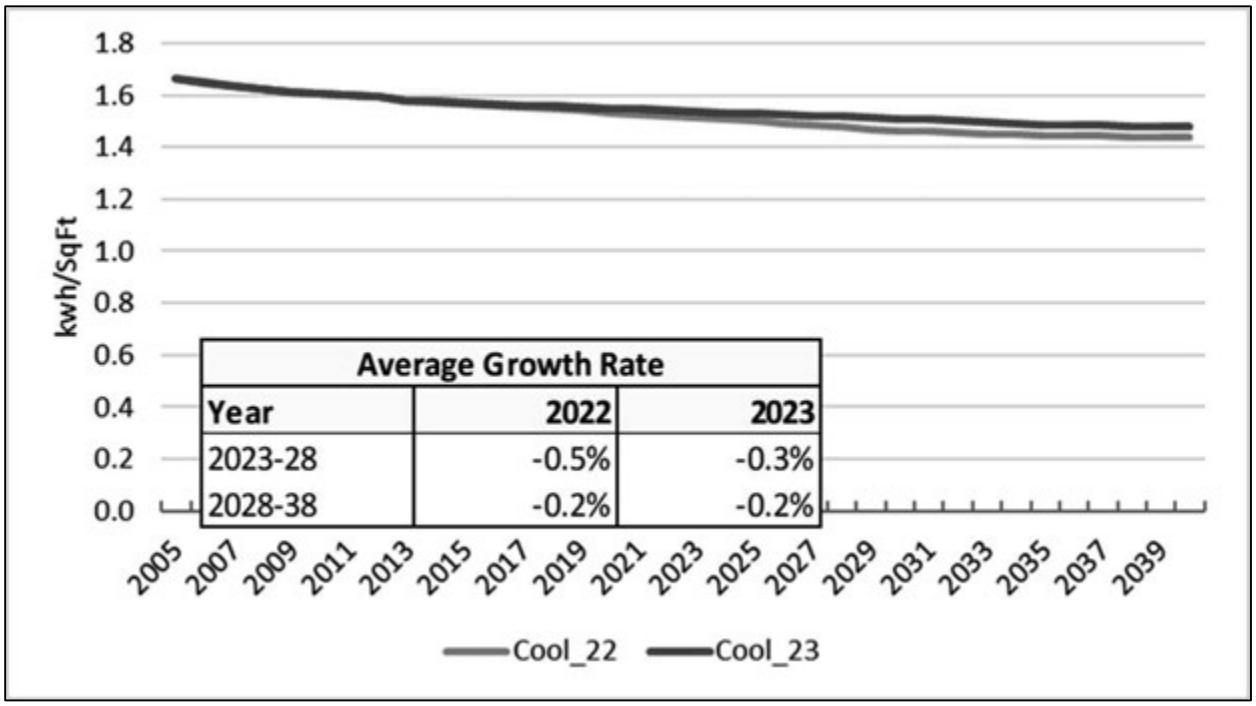
Figure 3: U.S. Electric Heating Intensity (kWh/SqFt)



Cooling

Cooling intensities are largely unchanged from the prior forecast. **Figure 4** compares AEO 2022 and AEO 2023 cooling intensity projections.

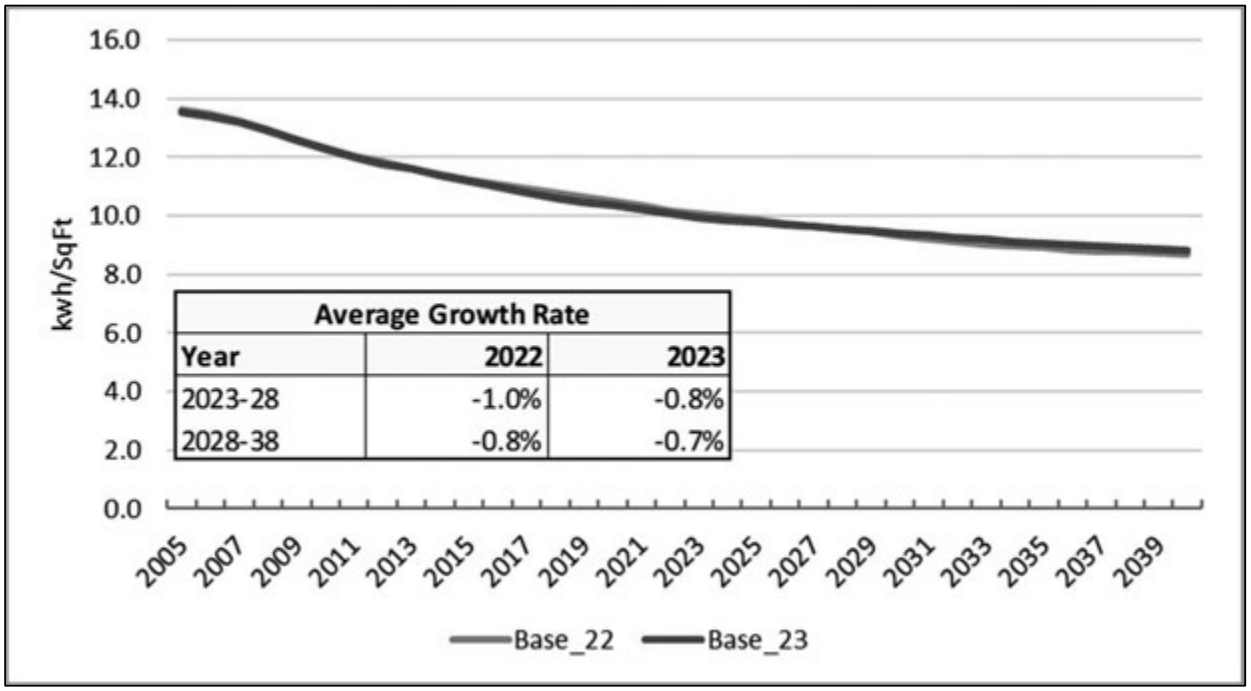
Figure 4: U.S. Cooling Intensity (kWh/SqFt)



Electric Other Use

Other large electric end uses include ventilation, refrigeration, lighting, office equipment and miscellaneous use. The 2023 base-use intensity declines slower than the prior forecast, largely due to revisions to lighting efficiency. The aggregation of these end-use intensities is shown in **Figure 5**.

Figure 5: U.S. Base Intensity (kWh/SqFt)

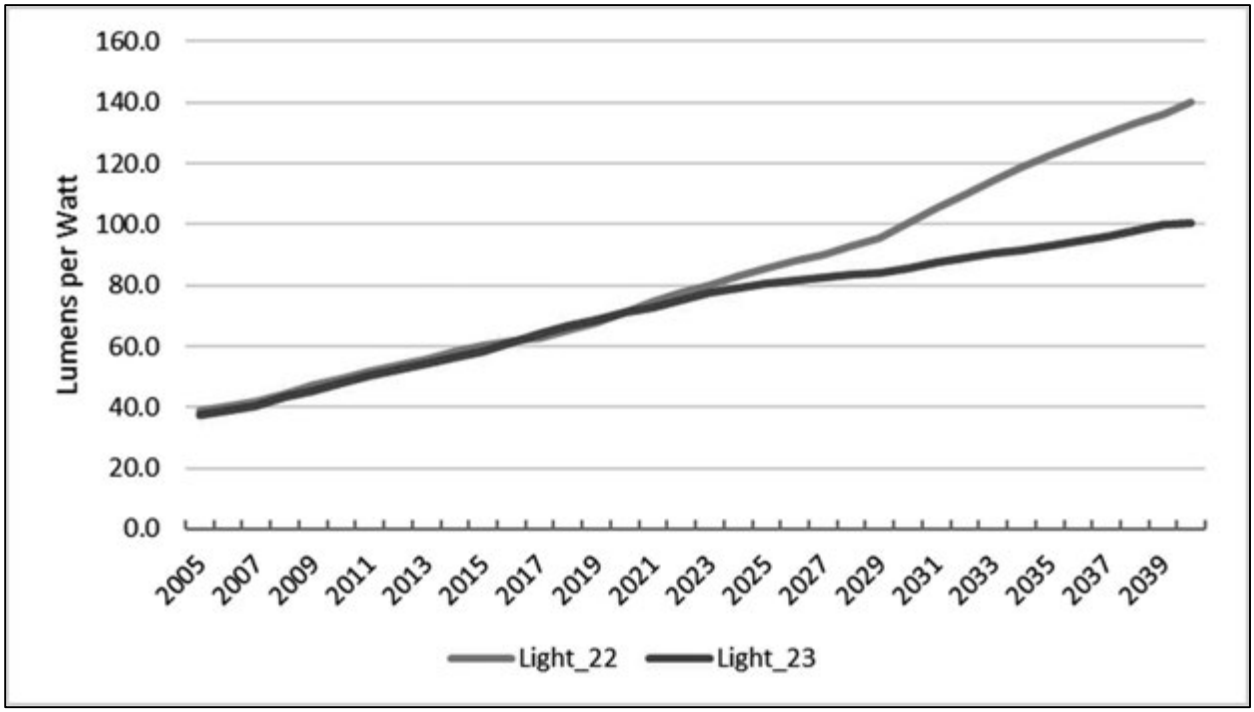


Average Growth Rate		
Year	2022	2023
2023-28	-1.0%	-0.8%
2028-38	-0.8%	-0.7%

Lighting

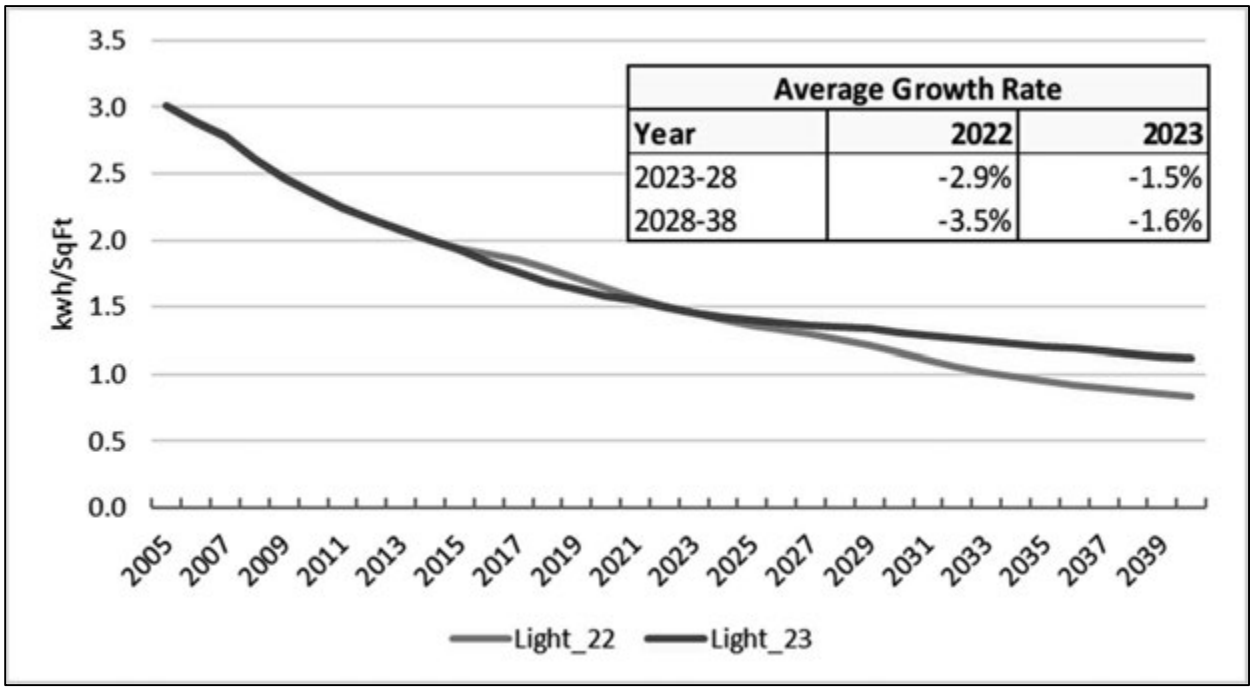
Lighting is the other large contributor to declining commercial energy intensity. In 2004, lighting accounted for 30% of commercial energy consumption. Today lighting accounts for roughly 12% of commercial building usage. Declines in lighting intensity have been driven by strong efficiency improvements with improvements expected to continue through the forecast period. The 2023 AEO incorporated new lighting cost and performance characteristics, this resulted in an upward revision to the lighting efficiency projections. **Figure 6** compares the 2023 and 2022 lighting efficiency projections, measured in lumens per watt.

Figure 6: Lighting Efficiency (Lumens per Watt)



As a result of the efficiency changes, lighting intensity projections are higher, **Figure 7** compares the 2023 and 2022 lighting intensity projections.

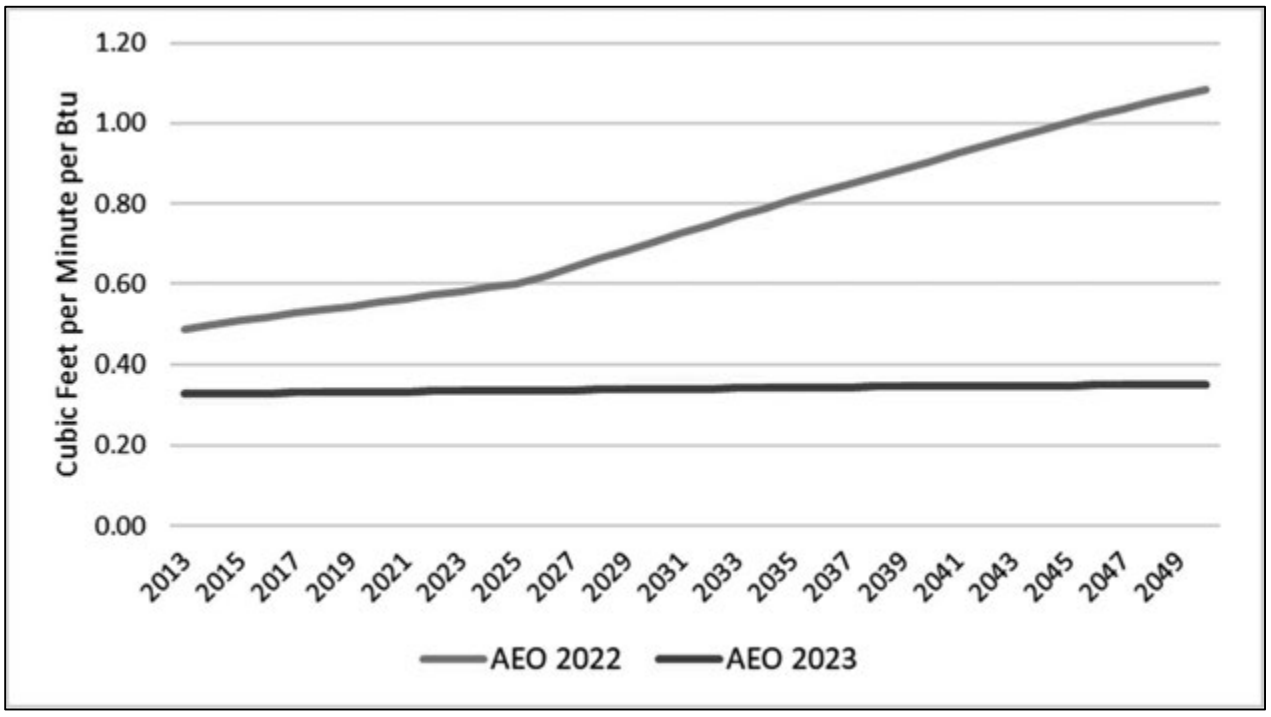
Figure 7: Lighting Intensity (kWh/SqFt)



Ventilation

Ventilation is one of the primary end-uses contributing to overall decline in commercial building use. Ventilation accounts for 13% of commercial building use. It is the fourth largest commercial end use. As commercial ventilation saturation is nearly 100 percent, changes in ventilation intensity are driven by changes in efficiency. Starting with the 2017 AEO, the EIA projected ventilation efficiency to improve 2.0% to 3.0% per year, resulting in a significant decline in intensity. The 2023 AEO incorporated new ventilation cost and performance characteristics, resulting in very different efficiency projections, as seen in **Figure 8**. Ventilation consumption projections have been revised down, which is inconsistent with the efficiency projections. This implies either lower utilization or square footage. In an effort to ensure the resulting ventilation intensity is consistent with the consumption projections, the 2023 SAE spreadsheets will utilize the 2022 ventilation projections. Further investigation and discussion with EIA will be pursued to ensure the most accurate assumptions are used going forward.

Figure 8: Ventilation Efficiency (Cubic Feet per Minute per Btu)



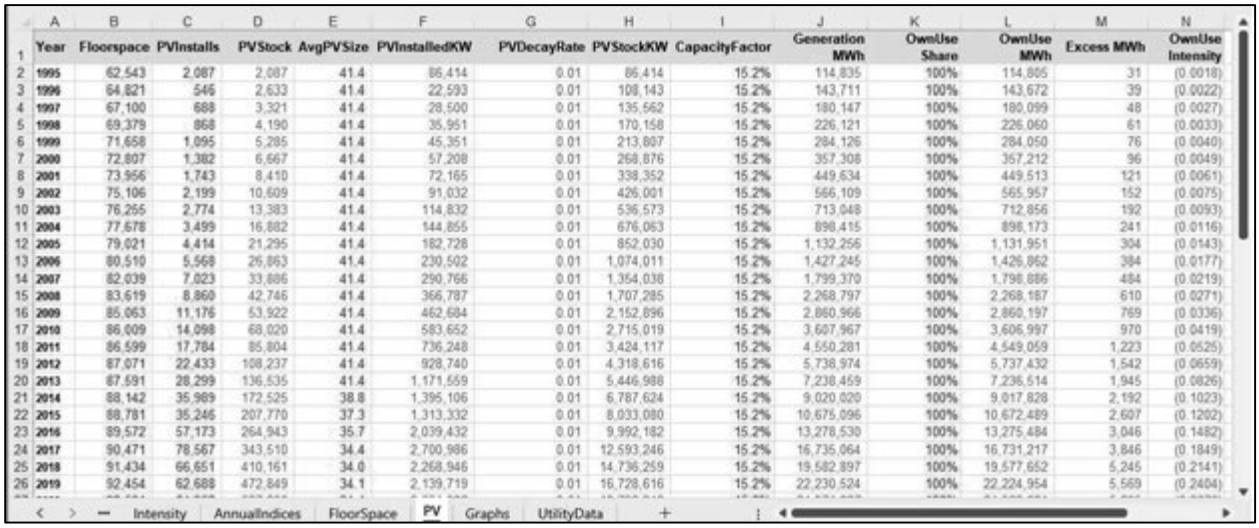
Solar Adjustment

Prior to the 2021 forecast, EIA subtracted solar generation from the end-use intensities. Itron would add back solar generation to reflect customer use rather than customer delivered energy. This adjustment is no longer needed as EIA is again forecasting customer use and not delivered energy.

PV Worksheet

The PV worksheet has been populated with regional solar data from the 2023 AEO. The PV worksheet, (**Figure 9**) calculates from left to right with EIA inputs in red and calculations in blue.

Figure 9: PV Worksheet



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Year	Floorspace	PVInstalls	PVStock	AvgPVSize	PVInstalledKW	PVDecayRate	PVStockKW	CapacityFactor	Generation MWh	OwnUse Share	OwnUse MWh	Excess MWh	OwnUse Intensity
2	1995	62,543	2,087	2,087	41.4	86,414	0.01	86,414	15.2%	114,835	100%	114,805	31	(0.0018)
3	1996	64,821	546	2,633	41.4	22,593	0.01	108,143	15.2%	143,711	100%	143,672	39	(0.0022)
4	1997	67,100	688	3,321	41.4	28,500	0.01	135,562	15.2%	180,147	100%	180,099	48	(0.0027)
5	1998	69,379	868	4,190	41.4	35,951	0.01	170,158	15.2%	226,121	100%	226,060	61	(0.0033)
6	1999	71,658	1,095	5,285	41.4	45,351	0.01	213,897	15.2%	284,126	100%	284,050	76	(0.0040)
7	2000	72,807	1,382	6,667	41.4	57,208	0.01	268,876	15.2%	357,308	100%	357,212	96	(0.0049)
8	2001	73,956	1,743	8,410	41.4	72,165	0.01	338,352	15.2%	449,634	100%	449,513	121	(0.0061)
9	2002	75,106	2,199	10,609	41.4	91,032	0.01	426,001	15.2%	566,109	100%	565,957	152	(0.0075)
10	2003	76,255	2,774	13,383	41.4	114,832	0.01	536,573	15.2%	713,048	100%	712,856	192	(0.0093)
11	2004	77,678	3,499	16,882	41.4	144,855	0.01	676,063	15.2%	898,415	100%	898,173	241	(0.0116)
12	2005	79,021	4,414	21,295	41.4	182,728	0.01	852,030	15.2%	1,132,256	100%	1,131,951	304	(0.0143)
13	2006	80,510	5,568	26,863	41.4	230,502	0.01	1,074,011	15.2%	1,427,245	100%	1,426,862	384	(0.0177)
14	2007	82,039	7,023	33,886	41.4	290,766	0.01	1,354,038	15.2%	1,799,370	100%	1,798,886	484	(0.0219)
15	2008	83,619	8,860	42,746	41.4	366,787	0.01	1,707,285	15.2%	2,268,797	100%	2,268,187	610	(0.0271)
16	2009	85,063	11,176	53,922	41.4	462,684	0.01	2,152,896	15.2%	2,860,966	100%	2,860,197	769	(0.0336)
17	2010	86,009	14,098	68,020	41.4	583,652	0.01	2,715,019	15.2%	3,607,967	100%	3,606,997	970	(0.0419)
18	2011	86,599	17,784	85,804	41.4	736,248	0.01	3,424,117	15.2%	4,550,281	100%	4,549,059	1,223	(0.0525)
19	2012	87,071	22,433	108,237	41.4	928,740	0.01	4,318,616	15.2%	5,738,974	100%	5,737,432	1,542	(0.0659)
20	2013	87,591	28,299	136,535	41.4	1,171,559	0.01	5,446,988	15.2%	7,238,459	100%	7,236,514	1,945	(0.0826)
21	2014	88,142	35,969	172,525	38.8	1,395,106	0.01	6,787,624	15.2%	9,020,020	100%	9,017,828	2,192	(0.1023)
22	2015	88,781	35,246	207,770	37.3	1,313,332	0.01	8,033,080	15.2%	10,675,096	100%	10,672,489	2,607	(0.1202)
23	2016	89,572	57,173	264,943	35.7	2,039,432	0.01	9,992,182	15.2%	13,278,530	100%	13,275,484	3,046	(0.1482)
24	2017	90,471	78,567	343,510	34.4	2,700,986	0.01	12,593,246	15.2%	16,735,064	100%	16,731,217	3,846	(0.1849)
25	2018	91,434	66,651	410,161	34.0	2,268,946	0.01	14,736,259	15.2%	19,582,897	100%	19,577,652	5,245	(0.2141)
26	2019	92,454	62,688	472,849	34.1	2,139,719	0.01	16,728,616	15.2%	22,230,524	100%	22,224,954	5,569	(0.2404)

Intensity | AnnualIndices | FloorSpace | PV | Graphs | UtilityData

The annual number of installed PV systems (Column C) are accumulated to total PV stock (Column D). This is translated to annual kW of installed capacity (Column F) by multiplying cumulative installed units by average system size (Column E). Capacity projection can be adjusted for solar degradation by setting a decay rate (Column G); Adjusted kW capacity (Column H) is calculated by applying the decay rate to prior year PV capacity estimate. Solar generation (Column J) is calculated as the product of adjusted solar capacity, capacity factor (Column I) and the number of hours in a year. Solar generation is either used onsite (own-use) or sold back to the grid (excess). Solar own-use is the product of total generation and own-use share (Column K); own-use share may vary significantly depending on local net metering laws. Solar own-use intensity (Column N) is derived by dividing own-use solar generation by square footage.

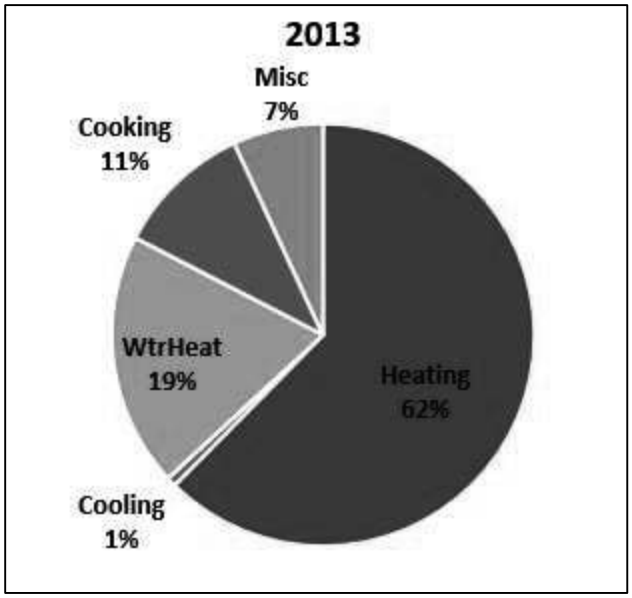
Gas Forecast Updates

Commercial gas intensities are calculated for the primary end uses, including:

- Space Heating
- Space Cooling
- Water Heating
- Cooking
- Miscellaneous

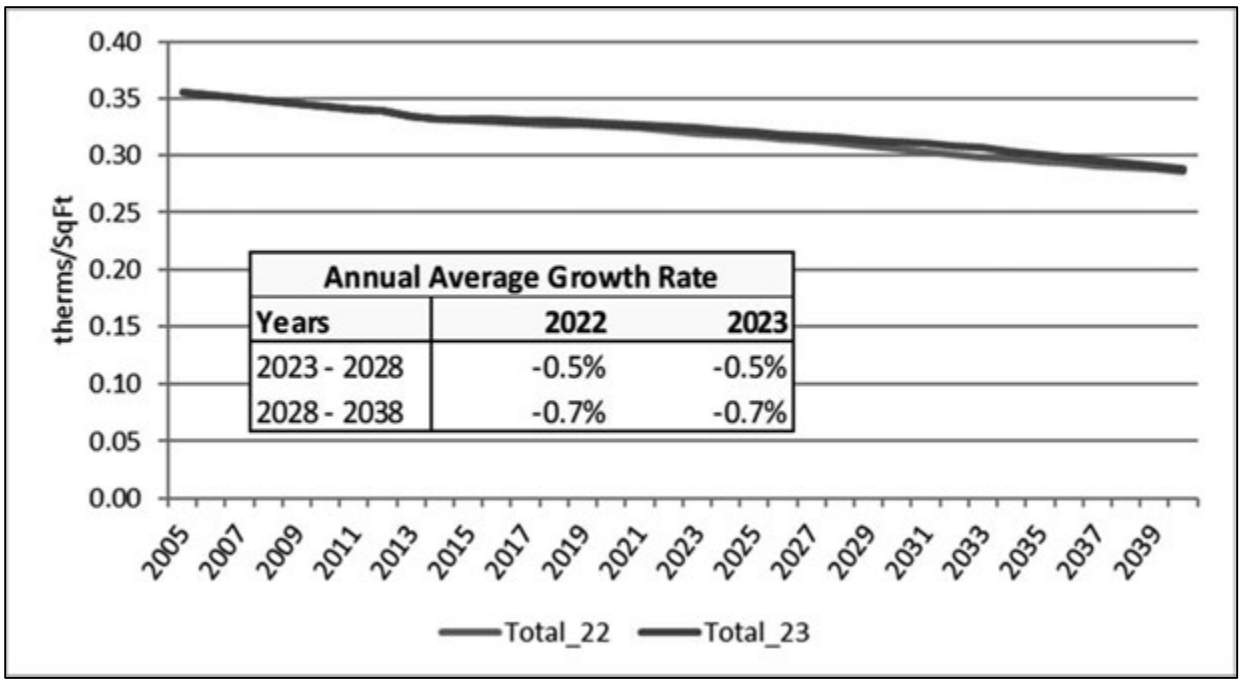
Figure 10 shows the base-year end-use shares.

Figure 10: Gas End-use Distribution



Total gas intensity (therms per SqFt) is largely unchanged from last year with intensity expected to decline 0.5% per year through 2028 and 0.7% in the subsequent 10 years. **Figure 11** compares the 2022 and 2023 total commercial building gas intensity.

Figure 11: Total Commercial Gas Intensity Forecast (therm/SqFt)

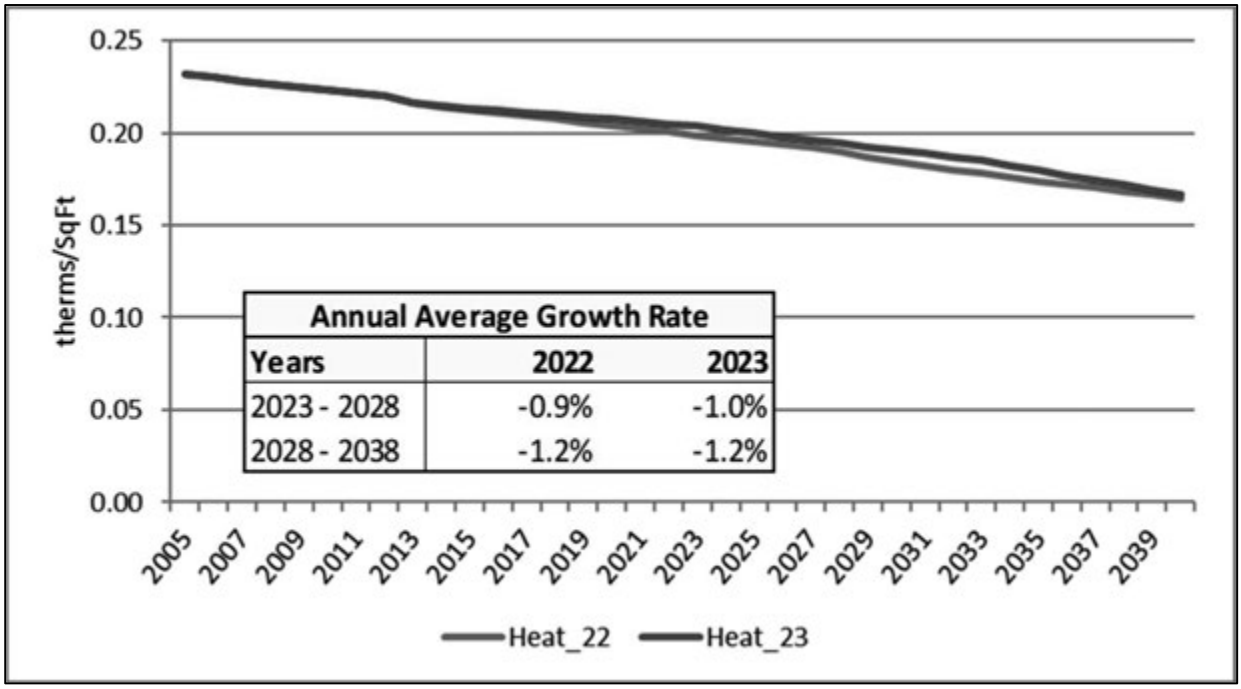


Annual Average Growth Rate		
Years	2022	2023
2023 - 2028	-0.5%	-0.5%
2028 - 2038	-0.7%	-0.7%

Gas Heating

Natural gas is the predominant energy source for commercial heating. Heating intensity is expected to decline at 1.0% per year through 2027, increasing to 1.2% through 2037. Figure 12 compares gas heating intensity projections.

Figure 12: Gas Heating Intensity (therm/SqFt)

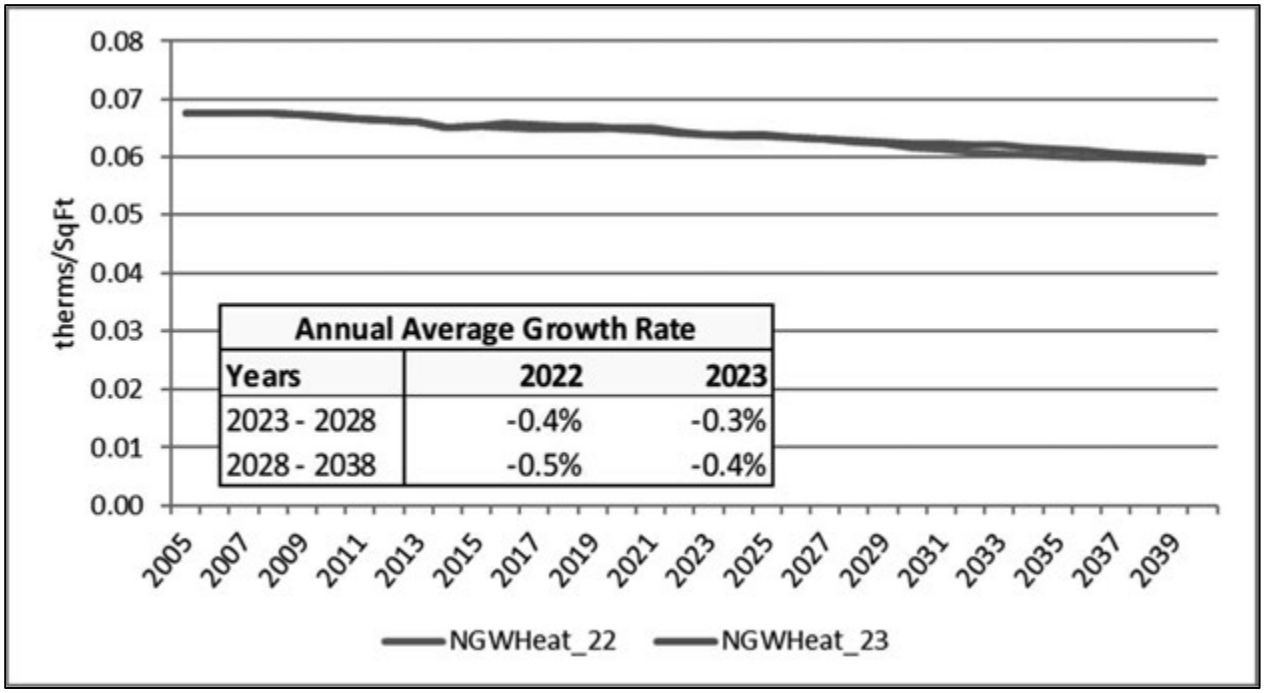


Annual Average Growth Rate		
Years	2022	2023
2023 - 2028	-0.9%	-1.0%
2028 - 2038	-1.2%	-1.2%

Gas Other End Uses

Water heating is the second largest end use accounting for approximately 20% of commercial gas use. As with heating, there are no significant changes. **Figure 13** compares the 2022 and 2023 gas water heating intensity projections.

Figure 13: Gas Water Heating Intensity Projections (therm/SqFt)



SAE Forecast Model Updates

MetrixND SAE models are constructed for each Census Division. The set of project files include simple floor stock models designed to mimic the EIA commercial sales forecast. In the floor stock models, monthly commercial sales are defined as a function of square footage (SqFt), end-use energy intensities (*CoolEI*, *HeatEI* and *OtherEI*) and monthly heating and cooling degree-day indices (*HDDIndex*, *CDDIndex*):

$$Sales_t = b_0 + b_1 \times (CoolEI_t \times SqFt_t \times CDDIndex_t) + b_2 \times (HeatEI_t \times SqFt_t \times HDDIndex_t) + b_3 \times (OtherEI_t \times SqFt_t) + e_t$$

The regional models incorporate EIA's 2023 end-use intensity and square footage projections. The models can be calibrated to an individual utility service area by replacing EIA historical and forecasted square footage with utility-specific square footage estimates. A standard approach for developing a square footage forecast is to estimate a square footage model as a function of commercial employment:

$$SqFt_{t=}a_0 + a_1 \times ComEmploy_t + e_t$$

For most utilities, historical floor stock data is difficult to construct. Further, the simple floor stock model may not adequately capture the impact of short-term variations in economic activity and rate changes. The new project files also include the SAE model specifications from earlier years. In the SAE specification, estimates of long-term monthly end-use energy are imported from the SAE spreadsheet, and interacted with GDP, price and weather conditions. An elasticity that is consistent with forecasts derived from the simple stock model is imposed on GDP. A description of the SAE model specification is outlined in Appendix A

Appendix A:
Commercial Statistically Adjusted End-Use Model

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. From a forecasting perspective, econometric models are well suited to identifying historical trends and to projecting these trends into the future. In contrast, end-use models can incorporate the end-use factors driving energy use. By including end-use structure in an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to the SAE approach.

- The equipment efficiency trends and saturation changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast, thereby providing a strong bridge between the two forecasts.
- By explicitly introducing trends in equipment saturations and efficiency levels, SAE models can explain changes in usage levels and weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be built into the final model.

This section describes this approach, the associated supporting Commercial SAE spreadsheets, and MetrixND project files that are used in the implementation. The source for the commercial SAE spreadsheets is the 2020 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

Statistically Adjusted End-Use Model Framework

The statistically adjusted end-use modeling framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$), and other equipment ($Other_{y,m}$). Formally,

$$USE_{y,m} = Heat_{y,m} + Cool_{y,m} + \text{Other}_{y,m} \quad (1)$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$USE_m = a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m \quad (2)$$

$XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, dwelling data, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

Constructing XHeat

As represented in the Commercial SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days,
- Heating intensity,
- Commercial output and energy price.

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier. That is,

$$XHeat_{y,m} = HeatIndex_{y,m} \times HeatUse_{y,m} \quad (3)$$

Where:

- $XHeat_{y,m}$ is estimated heating energy use in year (*y*) and month (*m*)
- $HeatIndex_{y,m}$ is the annual index of heating equipment
- $HeatUse_{y,m}$ is the monthly usage multiplier

The heating equipment index is composed of electric space heating intensity. The index will change over time with changes in heating intensity. Formally, the equipment index is defined as:

$$HeatIndex_y = HeatSales_{13} \times \frac{(HeatIntensity_y)}{(HeatIntensity_{13})} \quad (4)$$

In this expression, 2013 is used as a base year for normalizing the index. The ratio on the right is equal to 1.0 in 2013. In other years, it will be greater than 1.0 if intensity levels are above their 2013 level.

$$HeatSales_{13} = \left(\frac{kWh}{Sqft}\right)_{Heating} \times \left(\frac{CommercialSales_{13}}{\sum_e {}^{kWh}/_{Sqft_e}}\right) \quad (5)$$

Here, base-year sales for space heating is the product of the average space heating intensity value and the ratio of total commercial sales in the base year over the sum of the end-use intensity values. In the Commercial SAE Spreadsheets, the space heating sales value is defined on the *BaseYrInput* tab. The resulting $HeatIndex_y$ value in 2013 will be equal to the estimated annual heating sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, commercial level economic activity, and prices. Using the COMMEND default elasticity parameters, the estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{WgtHDD_{y,m}}{HDD_{13}}\right) \times \left(\frac{Output_y}{Outp_{13}}\right) \times \left(\frac{Price_{y,m}}{Price_{13}}\right)^{-0.18} \quad (6)$$

Where

- *WgtHDD* is the weighted number of heating degree days in year *y* and month *m*. This is constructed as the weighted sum of the current month's HDD and the prior month's HDD. The weights are 75% on the current month and 25% on the prior month
- *HDD* is the annual heating degree days for 2013,
- *Output* is a real commercial output driver in year *y*,
- *Price* is the average real price of electricity in month *m* and year *y*,

By construction, the $HeatUse_{y,m}$ variable has an annual sum that is close to 1.0 in the base year (2013). The first terms, which involve heating degree days, serves to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will reflect changes in commercial output and prices, as transformed through the end-use elasticity parameters. For example, if the real price of electricity goes up 10% relative to the base year value, the price term will contribute a multiplier of about .98 (computed as 1.10 to the -0.18 power).

Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days,
- Cooling intensity,
- Commercial output and energy price.

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$XCool_{y,m} = CoolIndex_y \times CoolUse_{y,m} \quad (7)$$

Where:

- $XCool_{y,m}$ is estimated cooling energy use in year y and month m,
- $CoolIndex_y$ is an index of cooling equipment, and
- $CoolUse_{y,m}$ is the monthly usage multiplier.

As with heating, the cooling equipment index depends on equipment saturation levels (*CoolShare*) normalized by operating efficiency levels (Eff). Formally, the cooling equipment index is defined as:

$$CoolIndex_y = CoolSales_{13} \times \frac{\left(CoolShare_y / Eff_y\right)}{\left(CoolShare_{13} / Eff_{13}\right)} \quad (8)$$

Data values in 2013 are used as a base year for normalizing the index, and the ratio on the right is equal to 1.0 in 2013. In other years, it will be greater than 1.0 if equipment saturation levels are above their 2013 level. This will be counteracted by higher efficiency levels, which will drive the index downward. Estimates of base year cooling sales are defined as follows.

$$CoolSales_{13} = \left(\frac{kWh}{Sqft}\right)_{Cooling} \times \left(\frac{CommercialSales_{13}}{\sum_e {}^{kWh}/_{Sqft_e}}\right) \quad (9)$$

Here, base-year sales for space cooling is the product of the average space cooling intensity value and the ratio of total commercial sales in the base year over the sum of the end-use intensity values. In the Commercial SAE Spreadsheets, the space cooling sales value is defined on the *BaseYrInput* tab. The resulting *CoolIndex* value in 2013 will be equal to the estimated annual cooling sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Cooling system usage levels are impacted on a monthly basis by several factors, including weather, economic activity levels and prices. Using the COMMEND default parameters, the estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{WgtCDD_{y,m}}{CDD_{13}}\right) \times \left(\frac{Output_y}{Output_{13}}\right) \times \left(\frac{Price_{y,m}}{Price_{13}}\right)^{-0.18} \quad (10)$$

Where:

- *WgtCDD* is the weighted number of cooling degree days in year (*y*) and month (*m*). This is constructed as the weighted sum of the current month's CDD and the prior month's CDD. The weights are 75% on the current month and 25% on the prior month.
- *CDD* is the annual cooling degree days for 2013.

By construction, the *CoolUse* variable has an annual sum that is close to 1.0 in the base year (2013). The first two terms, which involve billing days and cooling degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will change to reflect changes in commercial output and prices.

Constructing XOther

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Equipment intensities,
- Average number of days in the billing cycle for each month, and
- Real commercial output and real prices.

The explanatory variable for other uses is defined as follows:

$$XOther_{y,m} = OtherIndex_{y,m} \times OtherUse_{y,m} \quad (11)$$

The second term on the right-hand side of this expression embodies information about equipment saturation levels and efficiency levels. The equipment index for other uses is defined as follows:

$$OtherIndex_{y,m} = \sum_{Type} Weight_{13}^{Type} \times \left(\frac{Share_y^{Type} / Eff_y^{Type}}{Share_{13}^{Type} / Eff_{13}^{Type}} \right) \quad (12)$$

Where:

- Weight is the weight for each equipment type,
- Share represents the fraction of floor stock with an equipment type, and
- Eff is the average operating efficiency.

This index combines information about trends in saturation levels and efficiency levels for the main equipment categories. The weights are defined as follows.

$$Weight_{13}^{Type} = \left(\frac{kWh}{Sqft}\right)_{Type} \times \left(\frac{CommercialSa_{13}}{\sum_e {}^{kW}/_{Sqft_e}} \right) \quad (13)$$

Further monthly variation is introduced by multiplying by usage factors that cut across all end-uses, constructed as follows:

$$OtherUse_{y,m} = \left(\frac{BDays_{y,m}}{30.44}\right) \times \left(\frac{Output_y}{Output_{13}}\right) \times \left(\frac{Price_{y.m}}{Price_{13}}\right)^{-0.18} \quad (14)$$

In this expression, the elasticities on output and real price are computed from the COMMEND default values.

Supporting Spreadsheets and MetrixND Project Files

The SAE approach described above has been implemented for each of the nine census divisions. A mapping of states to census divisions is presented in Figure 1. This section describes the contents of each file and a procedure for customizing the files for specific utility data. A total of 18 files are provided. These files are listed in Table 1.

Figure 1: Mapping of States to Census Divisions

Table 1: List of SAE Electric Files

Spreadsheets	***MetrixND* Project Files**
NewEnglandCom23.xlsx	NewEnglandCom23.ndm
MiddleAtlanticCom23.xlsx	MiddleAtlanticCom23.ndm
EastNorthCentralCom23.xlsx	EastNorthCentralCom23.ndm
WestNorthCentralCom23.xlsx	WestNorthCentralCom23.ndm
SouthAtlanticCom23.xlsx	SouthAltanticCom23.ndm
EastSouthCentralCom23.xlsx	EastSouthCentralCom23.ndm
WestSouthCentralCom23.xlsx	WestSouthCentralCom23.ndm
MountainCom23.xlsx	MountainCom23.ndm
PacificCom23.xlsx	PacificCom23.ndm

As defaults, the SAE spreadsheets include regional data, but utility data can be entered to generate the *Heat*, *Cool* and *Other* equipment indices used in the SAE approach. The data from these spreadsheets

are linked to the MetrixND project files. In these project files, the end-use *Usage* variables (Equations 6, 10 and 14 above) are constructed and the SAE model is estimated.

The nine spreadsheets contain the following tabs.

- **EIAData** contains the raw forecasted data provided by the EIA.
- **BaseYrInput** contains base year Census Division intensities by end-use and building type as well as default building type weights. It also contains functionality for changing the weights to reflect utility service territory.
- **Efficiency** contains historical and forecasted end-use equipment efficiency trends. The forecasted values are based on projections provided by the EIA.
- **Shares** contains historical and forecasted end-use saturations.
- **Intensity** contains the annual intensity (kWh/sqft) projections by end use.
- **AnnualIndices** contains the annual *Heat*, *Cool* and *Other* equipment indices.
- **FloorSpace** contains the annual floor space (sqft) projections by end use.
- **PV** incorporates the impact of photovoltaic batteries into the forecast.
- **Graphs** contains graphs of Efficiency and Intensities, which can be updating by selecting from the list in cell B2.

The MetrixND project files contain the following objects.

Parameter Tables

- **Parameters.** This parameter table includes the values of the annual HDD and CDD in 2013 used to calculate the Usage variables for each end-use.
- **Elas.** This parameter table includes the values of the elasticities used to calculate the Usage variables for each end-use.

Data Tables

- **AnnualIndices.** This data table is linked to the *AnnualIndices* tab in the Commercial SAE spreadsheet and contains sales-adjusted commercial SAE indices.
- **Intensity.** This data table is linked to the *Intensity* tab in the Commercial SAE spreadsheet.
- **FloorSpace.** This data table links to *FloorSpace* tab in the Commercial SAE spreadsheet.
- **UtilityData.** This linkless data table contains Census Division level data. It can be populated with utility-specific data.

Transformation Tables

- **EconTrans.** This transformation table is used to compute the output and price indices used in the usage equations.
- **WeatherTrans.** This transformation table is used to compute the HDD and CDD indices used in the usage equations.
- **CommercialVars.** This transformation table is used to compute the *Heat*, *Cool* and *Other* Usage variables, as well as the *XHeat*, *XCool* and *XOther* variables that are used in the regression model. Structural variables based on the intensity/floor space combination are also calculated here.
- **BinaryVars.** This transformation table is used to compute the calendar binary variables that could be required in the regression model.

- **AnnualFcst.** This transformation table is used to compute the annual historical and forecast sales and annual change in sales.
- **EndUseFcst.** This transformation table breaks the forecast down into its heating, cooling, and other components.

Models

- **ComSAE.** The commercial SAE model (energy forecast driven by end-use indices, price, and output projections).
- **ComStruct.** Simple stock model (energy forecast driven by end-use energy intensities, and square footage).

Residential Statistically Adjusted End-Use (SAE) Spreadsheets – 2023 AEO Update

The Residential SAE spreadsheets and models have been updated reflect the Energy Information Administration's (EIA*) 2023 Annual Energy Outlook (AEO)*. The 2023 projections start in 2015 based on the the 2015 Residential Energy Consumption Survey (RECS). Between 2015 and through 2023 model parameters and inputs are adjusted to reflect actual end-use shipments data, weather conditions, number of households, prices, economic conditions, and state and federal energy efficiency policies. Going forward the end-use forecasts are driven by forecasted prices, end-use costs, efficiency standards, and expected impact of current state and federal efficiency progams including the recently passed Inflation Reduction Act (IRA). The SAE spreadsheets are based on the EIA Reference Case forecast. The Reference case reflects the impact of current efficiency programs, laws, and end-use standards.

The forecast incorporates the impact of the federal efficiency investment tax incentives associated with the IRA. As a result, overall residential intensities (kWh per household) are slightly lower than last year's forecast most Censu Divisions. In some Census Divisions there is very little change in intensity projectiosn from last year as other factors including slightly stronger heat pump sales associated with electrification activity counter stronger efficiency gains.

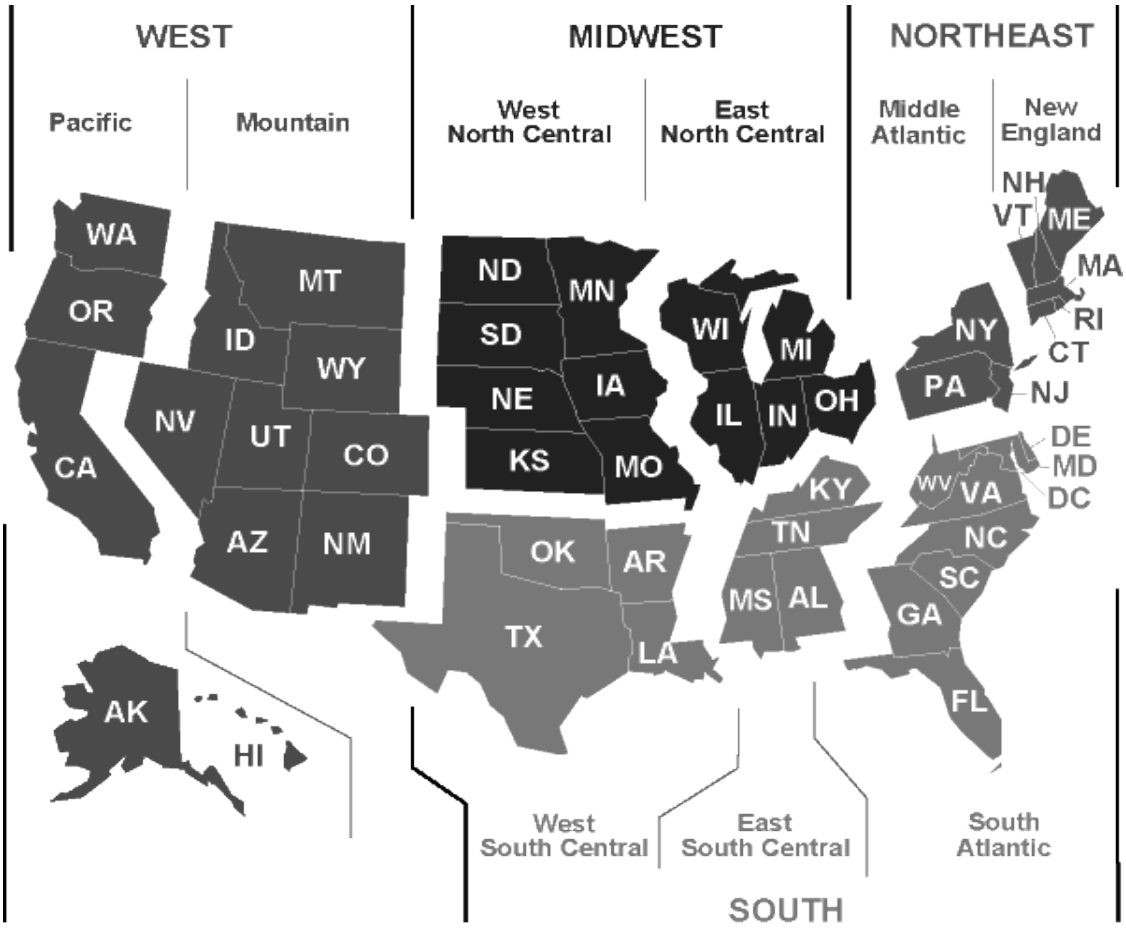
End-use intensity projections are constructed from end-use consumption data (12 end-use categories and three housing types), number of existing units (e.g., number of air conditioners), average end-use stock efficiency, average square footage, and heating and cooling thermal shell integrity trends. The data is used in developing end-use saturations, efficiencies projections, and end-use intensities that are inputs into SAE residential forecast models. The intensity projections reflect current and expected market conditions through the on-going data collection that includes appliance shipment data, appliance characteristic data, appliance standards, thermal shell information, regional energy efficiency (EE) program expenditures and rebates, electricity and gas prices, stock utilization, weather conditions, and EIA's calibration to actual residential customers and sales. .

The 2023 residential SAE spreadsheets and *MetrixND* project files include:

- Updated equipment efficiency trends.
- Updated equipment and appliance saturation trends.
- Updated structural indices.
- Updated annual heating, cooling, water heating, and non-HVAC indices.
- Updated regional sales forecasts.

EIA provides end-use detail for nine census divisions, depicted in Figure 1.

Figure 1: Forecast Census Divisions



Forecasts are generated from the National Energy Modeling System (NEMS). The NEMS model tracks appliance stock, stock efficiency, and usage change over time as appliances are replaced, new appliances are purchased, and utilization changes with changing economic, price, and weather conditions. Appliance choice decisions are driven by appliance costs, efficiency options and standards, natural gas availability, and fuel prices for electricity and natural gas. Forecasts are

developed for three housing types – single family, multi-family, and mobile homes, for twenty end-uses, including:

- Resistance heating/furnaces
- Air-source heat pumps (heating)
- Ground-source heat pumps (heating)
- Secondary heating
- Central air conditioning
- Air-source heat pumps (cooling)
- Ground-source heat pumps (cooling)
- Room air conditioning
- Water heating
- Cooking
- 1st refrigerators
- 2nd refrigerators
- Freezers
- Dishwashers
- Clothes washers
- Clothes dryers
- TVs and related equipment
- Furnace fans
- Lighting
- Miscellaneous

In the Statistically Adjusted End-Use (SAE) model, end-use intensities are combined with price, weather, and economic drivers to develop monthly estimates of heating (Xheat), cooling (XCool), and other use (XOther) energy requirements. The model variable are then used in estimating monthly average use models and projecting future monthly energy requirements. Through these constructed model variables, forecasts capture improvements in end-use efficiency driven by new standards, declining cost of high efficiency technology options, availability of new end-use technologies, price, economic activity, and weather conditions.

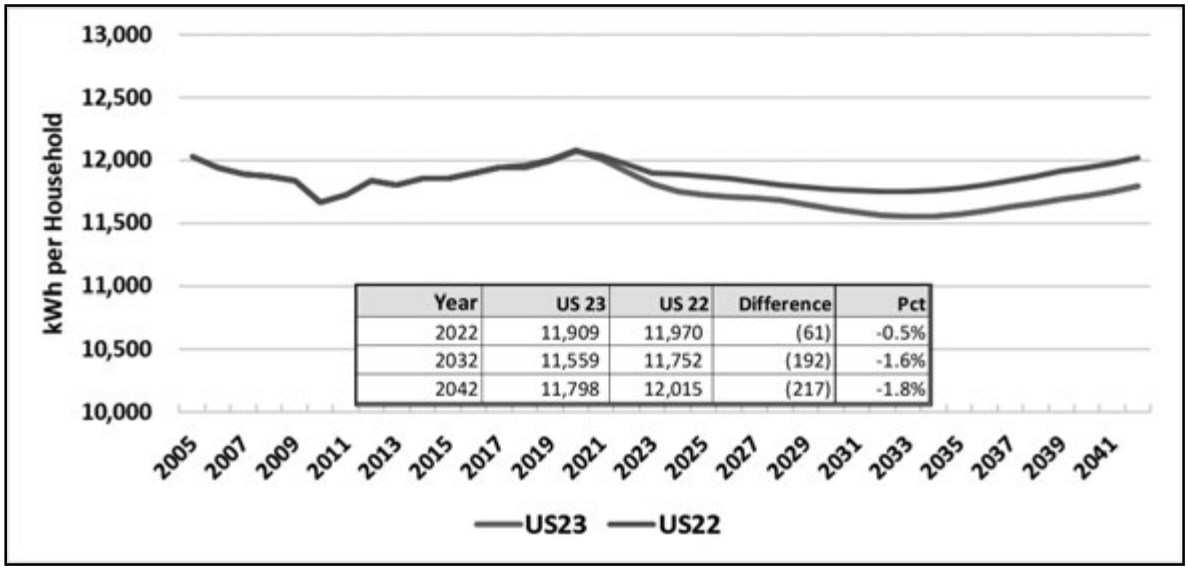
To support econometric modeling, Itron maintains and updates historical end-use data trends that are consistent with the 2015 RECS and prior RECS (i.e., the 2005 and 2009 RECS). Doing so sometimes requires adjusting historical end-use saturation and efficiency trends to reflect what EIA believes is the current state of appliance ownership, stock efficiency, and housing characteristics. The 2023 SAE spreadsheets reflect Itron's best estimates of historical end-use saturations, efficiency, and usage given EIA's 2015 base-year starting point and past estimates of end-use stock

characteristics. The SAE spreadsheets includes end-use intensity projections out through 2050. Separate spreadsheets are developed for electric and gas consumption.

Electricity

On the national level, total household intensity is lower than 2022 largely as result of expected improvements in end-use efficiency resulting from the IRA. Figure 2 compares the 2023 and 2022 U.S. household energy intensity projections.

Figure 2: U.S. Residential Total Intensity Trend

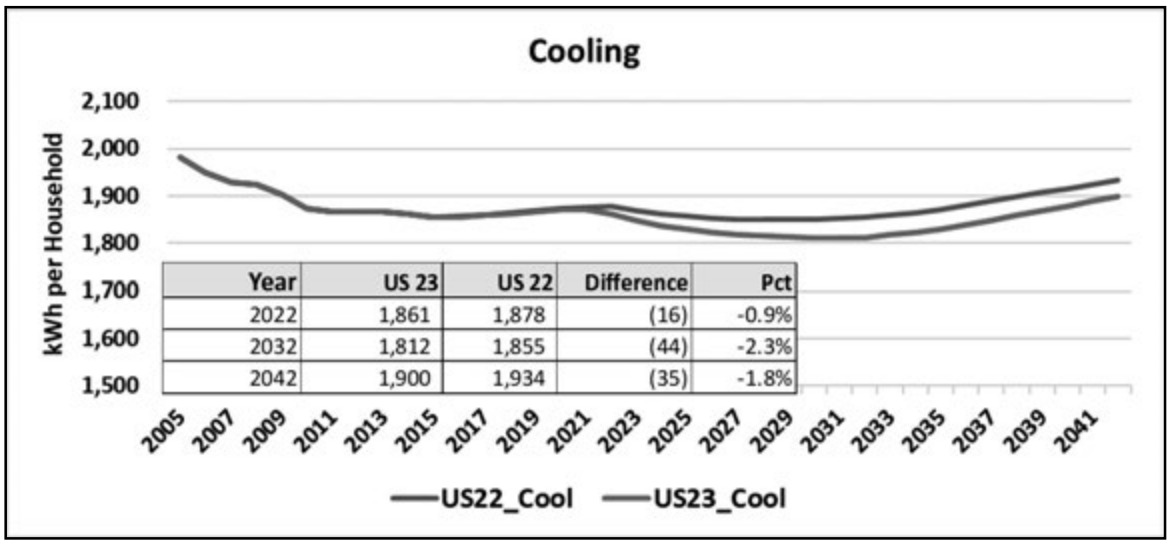


Year	US 23	US 22	Difference	Pct
2022	11,909	11,970	(61)	-0.5%
2032	11,559	11,752	(192)	-1.6%
2042	11,798	12,015	(217)	-1.8%

Over the next ten years, average residential intensity is projected to decline 0.3% annually; this compares with -0.2% decline in the 2022 forecast.

Figure 3 shows the 2023 and 2022 cooling intensities. The cooling intensity is also lower in the 2023 forecast declining 0.3% per year over the nex ten years compared with 0.1% annually in the 2022 forecast. The stronger intensity decline is largely due to higher heat pump and central air conditioning efficiency projections. IRA-related rebates reduce the costs of the more efficient technology options resulting in a higher mix of the more efficient technology options.

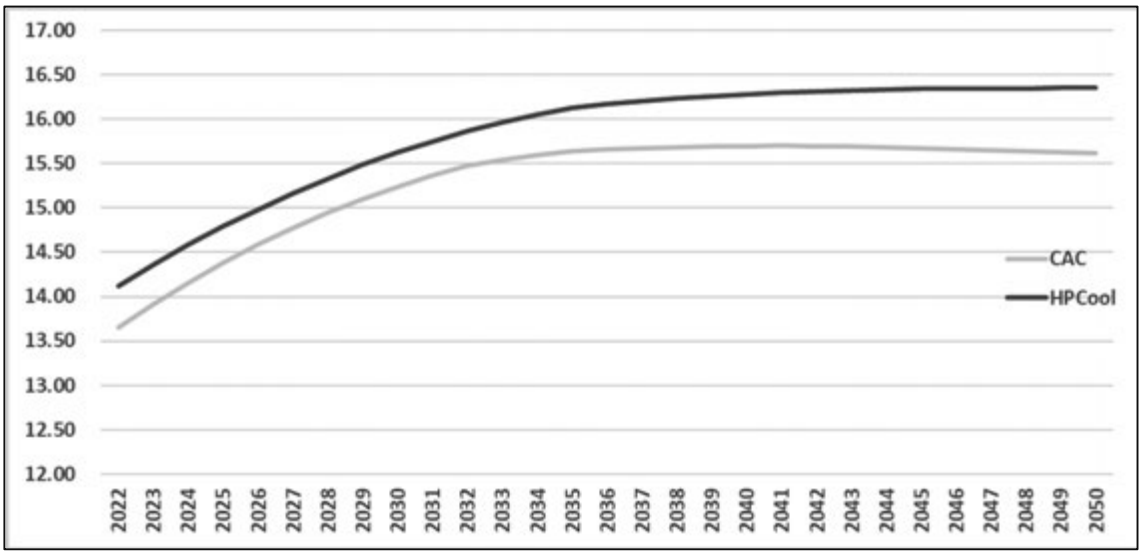
Figure 3: U.S. Residential Cooling Energy Intensities



Year	US 23	US 22	Difference	Pct
2022	1,861	1,878	(16)	-0.9%
2032	1,812	1,855	(44)	-2.3%
2042	1,900	1,934	(35)	-1.8%

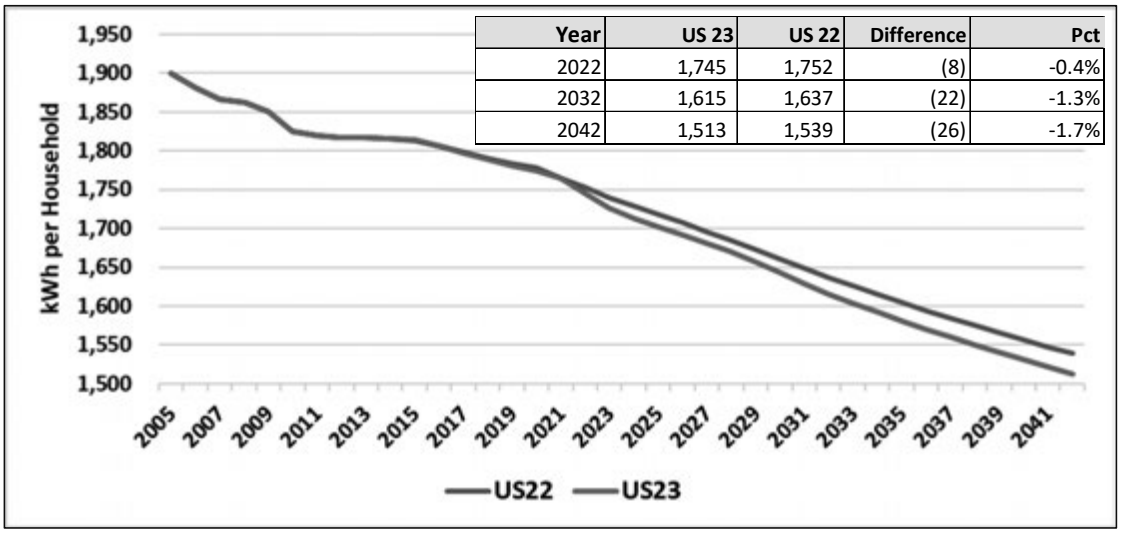
Cooling intensities turn positive after 2033 as cooling efficiency levels out and saturation of central cooling continue to increase (replacing room air conditioning). Figure 4 shows the expected central cooling system efficiency trend,

Figure 4: Central Cooling System Efficiency (SEER)



Heating intensity continues it's long-term decline as resistant heat saturation drops, and furnace fan and heat pump heating efficiency improves. Overall US heating saturation increases slowly from 35% in 2020 to 37% by 2050. at the US level is relatively flat at roughly 35%. Figure 5 shows US heating intensity projection.

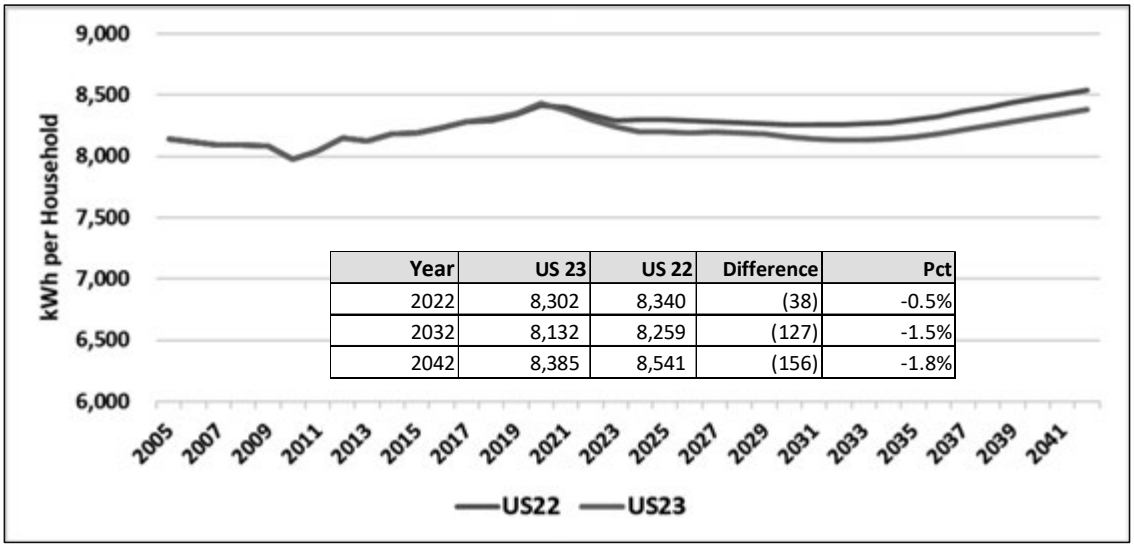
Figure 5: U.S. Heating Intensity



Year	US 23	US 22	Difference	Pct
2022	1,745	1,752	(8)	-0.4%
2032	1,615	1,637	(22)	-1.3%
2042	1,513	1,539	(26)	-1.7%

Figure 6 shows total intensity for the non-weather sensitive end-uses (*Other-Use*).

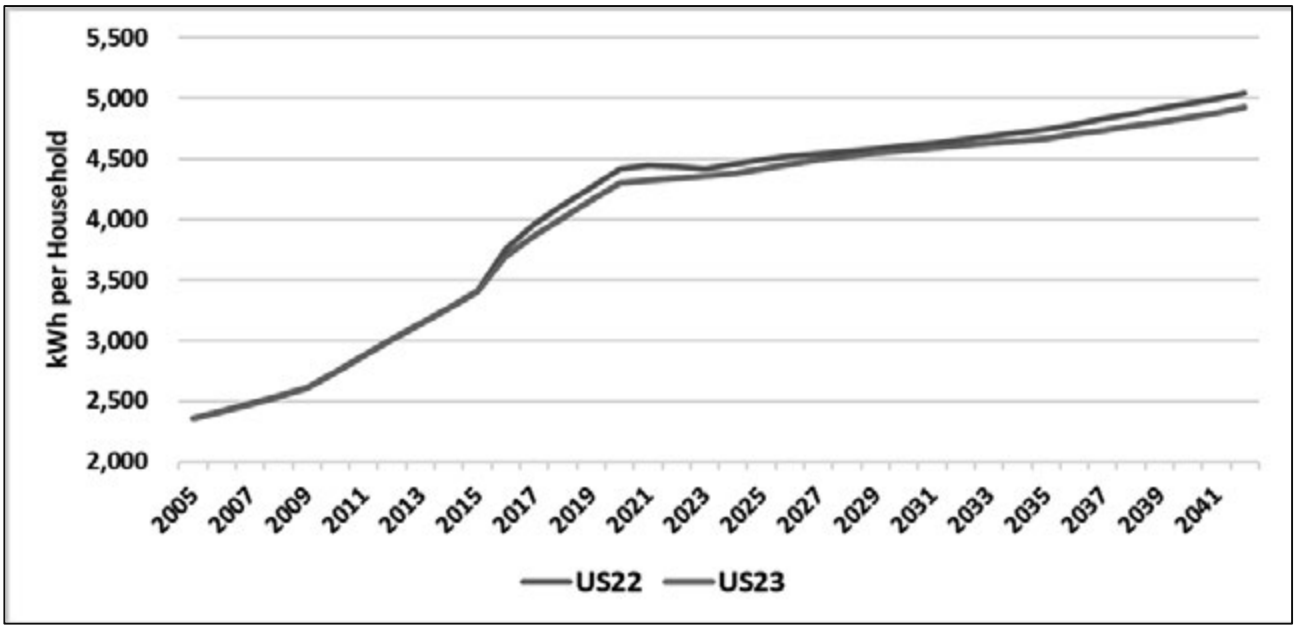
Figure 6: US Other-Use Intensity Trend



Year	US 23	US 22	Difference	Pct
2022	8,302	8,340	(38)	-0.5%
2032	8,132	8,259	(127)	-1.5%
2042	8,385	8,541	(156)	-1.8%

The 2023 OtherUse forecast is slightly lower than the 2022 forecast. OtherUse declines -0.2% annually through 2032. OtherUse turns positive after 2032 as appliance stock efficiency levels-off and small gains in end-use saturation coupled with relatively strong miscellaneous sales growth drives OtherUse and total house intensity positive. Figure 7 show the miscellaneous intensity trend.

Figure 7: U.S. Miscellaneous Intensity Trend



Since 2005, miscellaneous sales have increased from 20% of sales to over 35% of sales. By 2042 miscellaneous sales account for 40% of sales.

EV and PV Input Spreadsheets

As in last year's forecast, the 2023 spreadsheets include EV and PV forecast tabs. Forecast data is derived from EIA 2023 EV and PV forecasts. Figure 8 shows the electric vehicle (EV) worksheet.

Figure 8: EV Worksheet (update)

Year	Households	Vehicles Per HH	Vehicles	Elec Stock Share	Elec Vehicles	AnnualMiles	MilesPerkWh	UEC	Sales	Intensity
2020	18,475,139	2.08	38,476,517	0.6%	223,071	12,000	3.08	3,895	868,907	47.0
2021	18,595,831	2.06	38,302,557	0.7%	253,055	12,000	3.00	3,995	1,011,047	54.4
2022	18,716,069	2.04	38,265,592	0.7%	285,221	12,000	2.95	4,061	1,158,385	61.9
2023	18,832,472	2.03	38,266,490	0.8%	317,951	12,000	2.93	4,097	1,302,487	69.2
2024	18,948,043	2.02	38,324,073	0.9%	352,472	12,000	2.92	4,112	1,449,536	76.5
2025	19,067,257	2.02	38,432,108	1.0%	391,500	12,000	2.91	4,123	1,614,334	84.7
2026	19,185,904	2.01	38,535,465	1.2%	443,427	12,000	2.92	4,114	1,824,201	95.1
2027	19,300,338	2.00	38,598,483	1.3%	499,937	12,000	2.93	4,098	2,048,513	106.1
2028	19,411,864	1.99	38,645,462	1.5%	560,897	12,000	2.94	4,083	2,290,403	118.0
2029	19,521,151	1.98	38,671,258	1.6%	625,184	12,000	2.95	4,072	2,545,819	130.4
2030	19,629,134	1.97	38,681,680	1.8%	694,663	12,000	2.95	4,063	2,822,301	143.8
2031	19,735,350	1.96	38,691,919	2.0%	769,648	12,000	2.96	4,055	3,121,195	158.2
2032	19,840,592	1.95	38,688,564	2.2%	850,650	12,000	2.96	4,050	3,444,768	173.6
2033	19,942,910	1.94	38,691,245	2.4%	938,116	12,000	2.97	4,045	3,794,622	190.3
2034	20,042,312	1.93	38,704,711	2.7%	1,032,268	12,000	2.97	4,041	4,171,581	208.1
2035	20,141,631	1.92	38,717,511	2.9%	1,132,777	12,000	2.97	4,038	4,574,628	227.1
2036	20,238,442	1.91	38,722,361	3.2%	1,239,285	12,000	2.97	4,036	5,002,164	247.2
2037	20,333,673	1.90	38,731,368	3.5%	1,352,300	12,000	2.97	4,035	5,455,879	268.3
2038	20,428,323	1.90	38,745,562	3.8%	1,471,953	12,000	2.98	4,033	5,936,726	290.6
2039	20,522,184	1.89	38,754,018	4.1%	1,596,275	12,000	2.98	4,033	6,437,380	313.7
2040	20,616,078	1.88	38,756,935	4.5%	1,725,293	12,000	2.98	4,033	6,958,312	337.5

The red data are inputs from the EIA's transportation forecast. The values shown in blue are calculatons. The calculations are from right to left. The first two columns are census-level of number of households and average number of vehicles per household. The product gives total number of vehicles (column D). Column E is EIA's EV saturation forecast. Total EVs are the product of total vehicles and expected EV saturation (Column F). The other key inputs are expected annual miles driven (Column G)) and projected kWh per mile (Column H). While EV efficiency is expected to improve the average kWh per mile increase as a result total electric or battery electric vehcles (BEV) gaining market share over plug-in hybrid electric vehicles (PHEV). The annual use per car (UEC, column I) is calculated as the annual miles divided by average vehicle efficiency (kWh per mile). Total EV sales (Column J) are calculated as the product of EV vehicle stock and vehicle UEC. The EV chagrining intensity is derived by dividing total EV sales by total number of Households (Column K). You can add EV to XOther model variable or translate to a monthly EV charging sales and add to your residential average use forecast.

The PV worksheet is shown in Figure 9.

Figure 9: PV Worksheet (update)

Year	PVInstalls	PV Stock	AvgPVSize	PVStockKW	PVDecayRate	AdjPV_KW	CapacityFactor	Generation MWh	OwnUse Share	OwnUse MWh	Excess MWh	OwnUse Intensity
2020	161,737	1,480,572	5.69	8,427,376	0.01	8,353,615	16.3%	11,950,441	80%	9,560,353	2,390,088	(517.5)
2021	168,564	1,649,136	5.78	9,539,898	0.01	9,455,624	16.3%	13,473,487	80%	10,778,789	2,694,697	(579.6)
2022	136,616	1,785,751	5.85	10,455,222	0.01	10,359,823	16.2%	14,666,519	80%	11,733,215	2,933,304	(626.9)
2023	130,108	1,915,859	5.92	11,339,953	0.01	11,235,401	16.1%	15,812,419	80%	12,649,935	3,162,484	(671.7)
2024	126,292	2,042,151	5.97	12,198,741	0.01	12,085,341	16.0%	16,916,846	80%	13,533,477	3,383,369	(714.2)
2025	126,655	2,168,806	6.03	13,072,661	0.01	12,950,674	15.9%	18,046,720	80%	14,437,376	3,609,344	(757.2)
2026	130,489	2,299,295	6.08	13,986,083	0.01	13,855,356	15.9%	19,240,777	80%	15,392,621	3,848,155	(802.3)
2027	130,945	2,430,240	6.13	14,902,700	0.01	14,762,839	15.8%	20,439,922	80%	16,351,938	4,087,984	(847.2)
2028	130,865	2,561,095	6.18	15,831,768	0.01	15,682,741	15.8%	21,660,012	80%	17,328,009	4,332,002	(892.7)
2029	131,441	2,692,536	6.23	16,764,996	0.01	16,606,678	15.7%	22,887,264	80%	18,309,811	4,577,453	(937.9)
2030	133,668	2,826,203	6.27	17,727,400	0.01	17,559,750	15.7%	24,162,616	80%	19,330,093	4,832,523	(984.8)
2031	138,523	2,964,726	6.32	18,724,768	0.01	18,547,494	15.7%	25,495,225	80%	20,396,180	5,099,045	(1,033.5)
2032	140,343	3,105,069	6.36	19,749,272	0.01	19,562,024	15.7%	26,872,751	80%	21,498,200	5,374,550	(1,083.5)
2033	142,981	3,248,050	6.40	20,793,032	0.01	20,595,539	15.7%	28,282,121	80%	22,625,696	5,656,424	(1,134.5)
2034	144,976	3,393,026	6.44	21,865,852	0.01	21,657,922	15.7%	29,740,184	80%	23,792,147	5,948,037	(1,187.1)
2035	147,081	3,540,107	6.48	22,954,248	0.01	22,735,590	15.7%	31,223,908	80%	24,979,127	6,244,782	(1,240.2)
2036	148,160	3,688,266	6.52	24,065,444	0.01	23,835,902	15.7%	32,745,884	80%	26,196,707	6,549,177	(1,294.4)
2037	149,685	3,837,951	6.56	25,188,080	0.01	24,947,426	15.7%	34,287,059	80%	27,429,647	6,857,412	(1,349.0)
2038	150,079	3,988,030	6.60	26,328,676	0.01	26,076,795	15.7%	35,858,452	80%	28,686,761	7,171,690	(1,404.3)
2039	151,399	4,139,429	6.64	27,479,312	0.01	27,216,025	15.7%	37,447,143	80%	29,957,714	7,489,429	(1,459.8)
2040	152,841	4,292,270	6.68	28,656,188	0.01	28,381,395	15.7%	39,079,937	80%	31,263,949	7,815,987	(1,516.5)

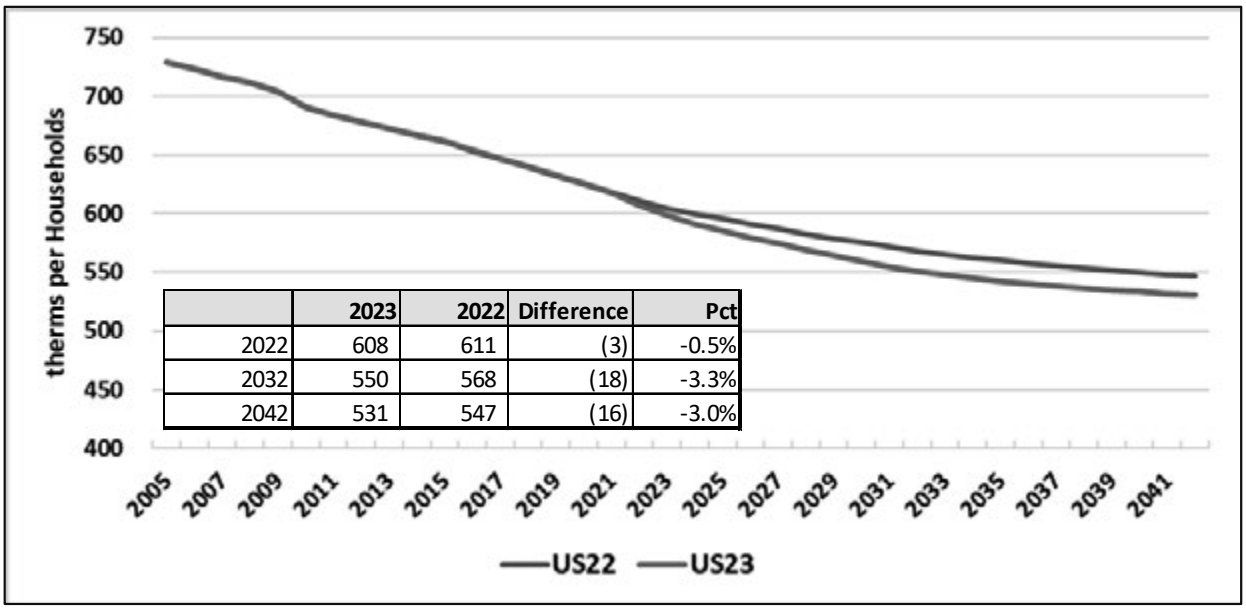
The calculations are right from left starting with the number households and number of installed systems. EIA inputs are in red, green shows user-defined inputs, and calculations are blue. Total stock (Column D) is calculated as the cumulation of number of installed systems (Column C). Installed kW capacity (Column F) is the product of PV Stock and average PV size (Column E). Capacity projection can be adjusted for solar degradation by setting a decay rate (Column G); Adjusted kW capacity (Column H) is calculated by applying the decay rate to prior year PV capacity estimate. Solar Generation (Column J) is derived by applying the capacity factor (Column I) to adjusted installed capacity. Total solar generation is split into own-use (that consumed by the customer) and excess (that sold back to the grid). Own-use intensity (Column N) is calculated by dividing own-use generation by the number of households. The PV own-use intensity can be imported into your residential forecast file and used to adjust your residential average use forecast.

Natural Gas

Space heating and water heating account for over 95% of residential natural gas usage, with cooking and clothes dryers accounting for the remainder. At the U.S. level, roughly 50% of households have gas space and water heating. The share of homes with gas space heat has been relatively constant and is expected to increase just slightly over the next 20 years.

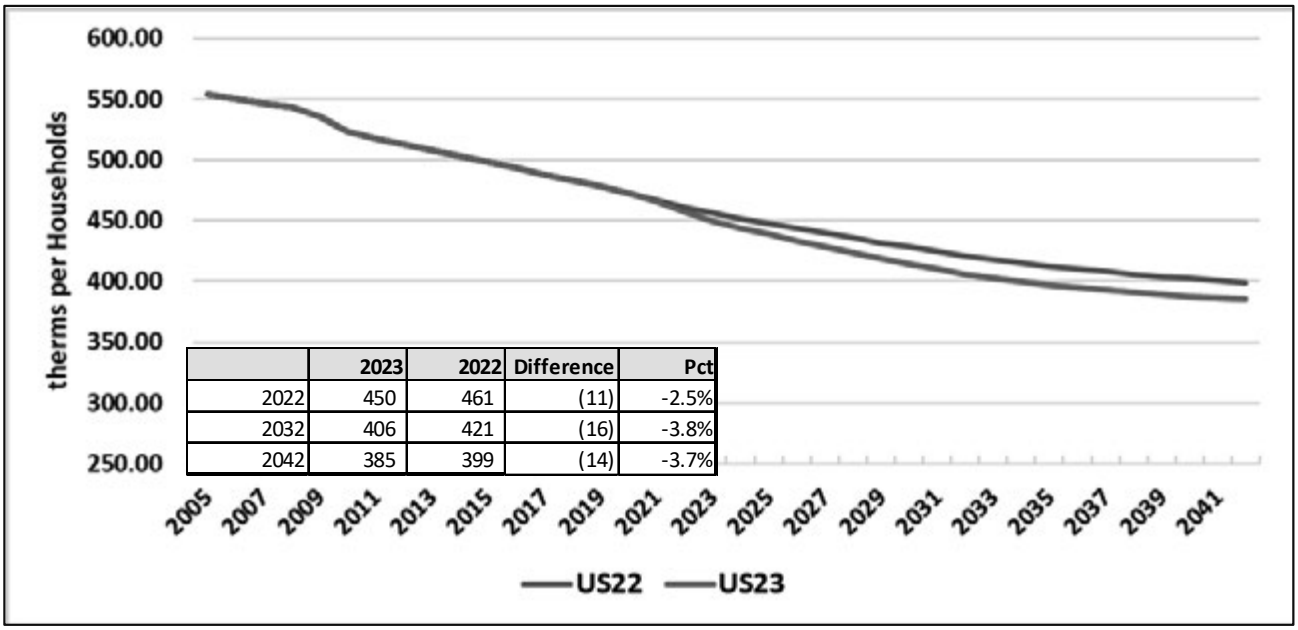
Over the last 10 years, there have been significant improvements in heating system efficiency and housing thermal insulation; these gains are expected to continue over the next thirty years. Given a relatively small increase in gas heat saturation, efficiency improvements drive gas intensity lower. In comparison with the 2022 forecast, the 2023 heating intensity (which represents 75% of gas use) and as a result total household intensities are lower. The 2023 intensities are lower reflecting higher real gas pricess, The IRA that encourages adoption of more efficient gas heating systems and improvements in thermal shell efficiency, and slower saturation growth as EIA projects stronger electric heat pump saturation in several regions of the country. Figure 10 and Figure 11compares the 2022 and 2023 total and gas heating intensity projections.

Figure 10: U.S. Total Gas Intensity



	2023	2022	Difference	Pct
2022	608	611	(3)	-0.5%
2032	550	568	(18)	-3.3%
2042	531	547	(16)	-3.0%

Figure 11: U.S. Gas Heating Intensity

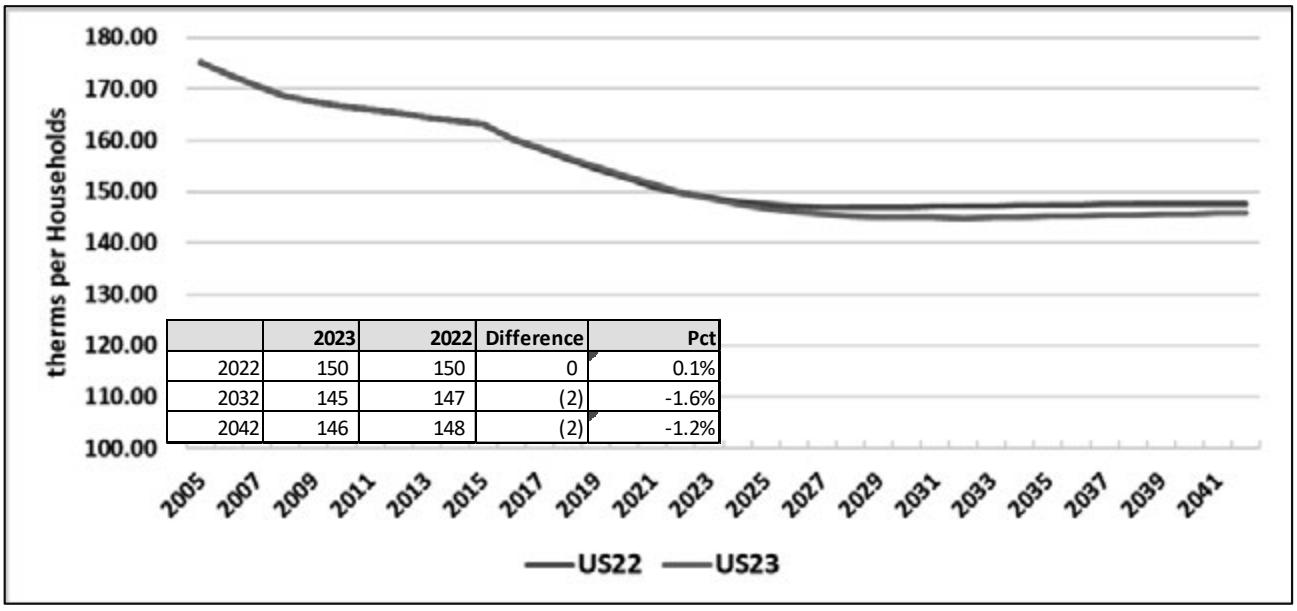


	2023	2022	Difference	Pct
2022	450	461	(11)	-2.5%
2032	406	421	(16)	-3.8%
2042	385	399	(14)	-3.7%

Gas heating intensity declines 1.2% annually over the next ten years compared with 0.9% per year in the 2022 forecast.

Water heating, dryers, and cooking account for the remaining 25% of gas use. While efficiency continues to improve across all three technologies, the impact is more muted with 2023 average intensity declining 0.3% per year. This compares with 0.2% per year in the 2022 forecast. Figure 12 compares the 2023 and 2022 intensity projections for the other non-weather sensitive end-uses (water heat, cooking, and dryers).

Figure 12: U.S. Other Gas Use Intensity



	2023	2022	Difference	Pct
2022	150	150	0	0.1%
2032	145	147	(2)	-1.6%
2042	146	148	(2)	-1.2%

Summary

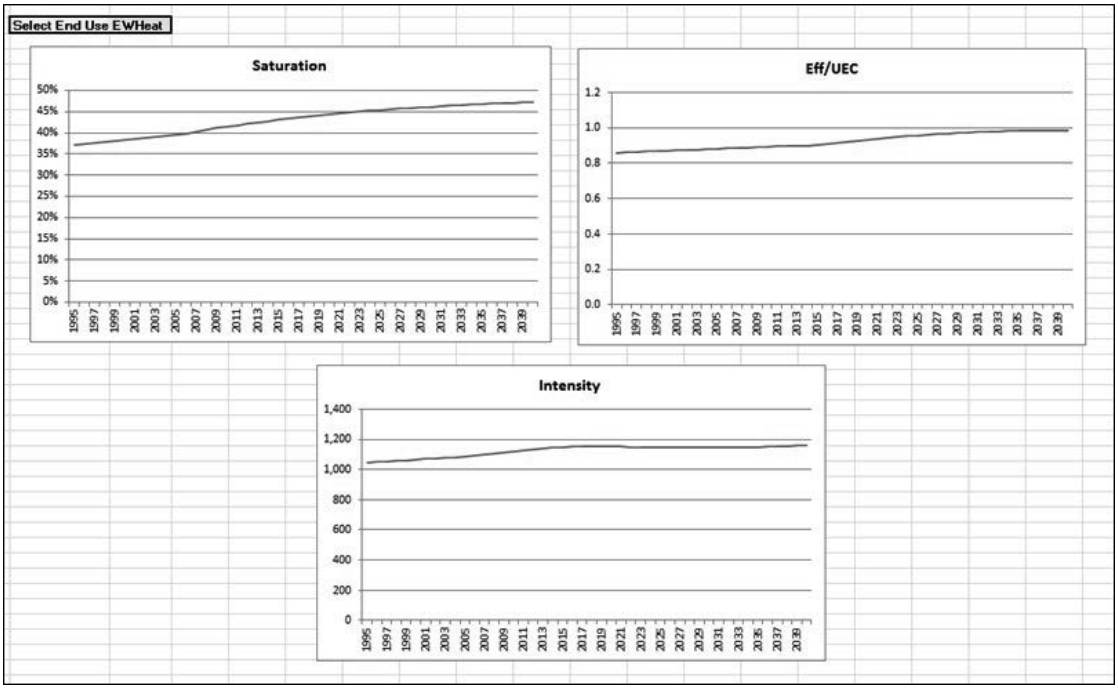
The 2023 electric and gas intensity projections are in general lower than 2022. The primary factor is the recent passage of the IRA that provides significant funding in terms of tax credits at the federal level and incentives/technology rebates at the state level. Higher real energy prices also contribute to adoption of more efficient technology options, and in some regions electrification results in higher electric heat saturation and conversely lower gas heat saturation.

Appendix A: Using the SAE Spreadsheets

Updates to the SAE Spreadsheets

Itron continually works to simplify and improve the SAE spreadsheets to allow analysts to view end-use intensity trends, to understand how the indices are calculated, and to customize the SAE inputs (such as end-use saturations and starting UEC) to their own service area. Last year, Itron added a new "graph" tab that allows the analyst to select an end-use and graph the end-use saturation, efficiency/UEC, and calculated intensity. Figure 13 shows this feature for electric water heaters.

Figure 13: SAE Spreadsheet End-Use Graph - Electric Water Heat



SAE Spreadsheet Organization

The SAE spreadsheets are organized to allow the analyst to calibrate end-use intensities to a specific utility service area organization where service area specific saturation and UEC estimates are available. The spreadsheet tabs include:

- **Definitions** provides descriptive information about end-uses, units and brief descriptions of the other worksheets.
- **EIAData** contains EIA efficiency, consumption, equipment stock, household, floor space and price projections.
- **Calibration** provides base year usage information. It can also be used to customize the spreadsheet to the user's service territory. Figure 14 shows the layout of the Calibration worksheet.

Figure 14: Calibration Worksheet

	A	B	C	D	E	F	G	H	I	J	K
1	Base Year (2009)	EFurn	HPHeat	GHPHeat	SecHt	CAC	HPCool	GHPCool	RAC	EWHeat	ECook
2	Consumption (mmBtu)	295,156,965	49,006,093	3,298,852	60,466,462	469,614,726	92,426,664	4,189,994	68,043,412	428,267,637	104,815,834
3	Equipment Stock (units)	29,626,185	9,099,838	699,168	28,312,038	61,707,187	9,099,838	699,168	49,101,682	46,763,693	68,137,629
4	UEC (kWh/unit)	2,920	1,578	1,383	626	2,230	2,977	1,756	406	2,684	451
5	Share (%)	26.0%	8.0%	0.6%	23.4%	54.2%	8.0%	0.6%	43.1%	41.1%	59.9%
6	Raw Intensity (kWh/year)	760	126	8	147	1,209	238	11	175	1,103	270
7	Model Scaled Intensity (kWh/year)	760	126	8	147	1,209	238	11	175	1,103	270
8											
9	Observed Use Per Customer (kWh/year)	11,909									
10	Adjustment Factor	1.010									
11	Adjusted Intensity (kWh/year)	768	127	9	148	1,222	240	11	177	1,114	273
12											
13	XHeat	1.000									
14	XCool	1.000									
15	XOther	1.000									
16											

Base-year use-per-customer (kWh) for the utility service area is depicted in Row 9 and can be used to calibrate the spreadsheet to the user's service territory. To do this, substitute your weather-normalized average use for the Census Division average-use in Cell B9.

In additional to basic calibration to observed usage, in 2017 we have also added another layer of calibration to better tailor the regional data to utility-specific conditions. To get better starting estimates of electric usage by end-use, we have utilized MetrixND models to "true up" EIA estimates to the regions. You can do this on the utlity level by substituting the adjustment factors in cells B13-15 with estimated coefficients on SAE variables in your residential model. Figure 15 below provides an example.

Figure 15: Model-Based Calibration

	A	B	C	D	E	F	G	H	I	J	K
1	Base Year (2009)	EFurn	HPHeat	GHPHeat	SecHt	CAC	HPCool	GHPCool	RAC	EWHeat	ECook
2	Consumption (mmBtu)	295,156,965	49,006,093	3,298,852	60,466,462	469,614,726	92,426,664	4,189,994	68,043,412	428,267,637	104,815,834
3	Equipment Stock (units)	29,626,185	9,099,838	699,168	28,312,038	61,707,187	9,099,838	699,168	49,101,682	46,763,693	68,137,629
4	UEC (kWh/unit)	2,920	1,578	1,383	626	2,230	2,977	1,756	406	2,684	451
5	Share (%)	26.0%	8.0%	0.6%	23.4%	54.2%	8.0%	0.6%	43.1%	41.1%	59.9%
6	Raw Intensity (kWh/year)	760	126	8	147	1,209	238	11	175	1,103	270
7	Model-Scaled Intensity (kWh/year)	1,853	308	21	358	2,389	470	21	346	677	166
8											
9	Observed Use Per Customer (kWh/year)	11,909									
10	Adjustment Factor	0.999									
11	Adjusted Intensity (kWh/year)	1,852	307	21	357	2,387	470	21	346	677	166
12											
13	XHeat	2.438									
14	XCool	1.975									
15	XOther	0.614									
16											

In this case, model-based calibration adjusts heating and cooling starting year usage up based on model coefficients estimated from observed use per customer data. Other usage is adjusted downward.

Resulting end-use intensities are written to the Intensities tab. MetrixND project files can link to the Intensities tab as the source-data for the constructing of SAE model variables.

StructuralVars

This worksheet contains data about the size of homes and their building shell efficiencies. The results of the calculations on this tab are used in the development of energy intensities for heating and cooling end-uses.

Analysts can substitute local household and floor space estimates for the regional estimates to reflect local conditions in the final energy intensities. Total floor space can be modified in Column E and number of households in Column I.

Shares

The Shares tab contains historical saturation estimates and forecasts developed by the EIA. Data from appliance saturation surveys can be used to modify the default saturations. Depending on data availability, these changes can either shift the projections up or down (one survey) or modify the growth rate in the trends (two or more surveys).

Efficiencies

The Efficiencies tab provides historical and forecasted end-use efficiency. UEC estimates are used as a proxy for efficiency where specific technology efficiency data (as central air conditioner SEER) are not available. Efficiency trends can also be modified to reflect the utility service area. As a practical matter however, average efficiency for most equipment varies little between regions.

Intensities

Intensities are per-household end-use energy estimate derived from combining end-use saturation, efficiency, and starting UEC. If the user changes saturation and/or efficiency, the changes are reflected in the end-use intensity calculations.

MonthlyMults

This tab provides seasonal multipliers for non-HVAC end-uses. This allows us to accurately gauge seasonal usage for such non-weather sensitive end-uses as water heating, refrigeration, and lighting.

Graphs

The Graphs tab provides an interface to select an end-use and view historical and projected end-use saturation, efficiency (or UEC where an efficiency measure is not available) and resulting end-use intensity.

EV

Electric vehicle load is added to the base (other) end-use in the SAE model. Input data rows are highlighted in red and include:

- **Households** - Historical and forecasted number of households (column B)
- **EVSold** - Number of EV vehicles sold in any given year (column C)
- **EVDecay** - Number of EV vehicles removed (column D)
- **AnnualMiles** - Annual average miles driven (column G)
- **MilePerKwh** - Average vehicle efficiency (column H)

Additional columns include:

- **EVStock** - Calculated as the sum of all new purchases minus vehicle decay (column E).
- **Share** - The share of households with EVs (column F), calculated as *EVStock* / *Households*.

- **UEC -** The Unit Energy Consumption (kWh) for those households that own an EV. Calculated as the number of miles driven divided by the average vehicle miles per kWh (column I).
- **EV_EI** - Use per household (column K), calculated by multiplying total EV Sales by number of households. The resulting annual EV energy intensity is on a kWh per household basis and can be added to the base or *other use index* in the SAE model.

PV

The SAE spreadsheets also include a worksheet for calculating PV (photovoltaic) energy impacts. Input data rows are highlighted in red and include:

- **Households** - Historical and forecasted Households or customers (column B)
- **PVInstalls** - Number of new PV installations (column C)
- **AvgPVSize** - Average PV kW capacity (column E)
- **PVDecayKW** - PV capacity decay in kW (column G)
- **CapacityFactor** - Capacity Factor (column I)

Additional columns include:

- **PVStockKW** - Estimated PV kW capacity (column H), calculated by summing current and all past PV installed capacity and subtracting the decay, calculated as:

$$(PVInstalls \times AvgPVSize) - PVDecayKW$$

- **PVEnergy** - PV MWh (column J) is derived by applying the capacity factor to the PV Capacity Stock, calculated as:

$$(PVStockKW \times 8760 \times CapacityFactor)/1000$$

- **PV_OwnEI**- Final PV energy intensity (column K) is derived by dividing *OwnUse MWh* by total number of households. The estimate is negative, as it represents a load reduction.

Appendix B: Residential SAE Modeling Framework

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. Econometric models are well suited to identifying historical trends and to projecting these trends into the future. In contrast, end-use models can identify and isolate the end-use factors that are driving energy use. By incorporating end-use structure into an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to this approach.

- The equipment efficiency and saturation trends, dwelling square footage, and thermal integrity changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast. This provides a strong bridge between the two forecasts.
- By explicitly incorporating trends in equipment saturations, equipment efficiency, dwelling square footage, and thermal integrity levels, it is easier to explain changes in usage levels and changes in weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic, and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be incorporated into the final model.

This section describes this approach, the associated supporting SAE spreadsheets, and the *MetrixND* project files that are used in the implementation. The main source of the SAE spreadsheets is the 2022 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

Statistically Adjusted End-Use Modeling Framework

The statistically adjusted end-use modeling framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$), and other equipment ($Other_{y,m}$). Formally,

$$\mathrm{USE}_{y,m} = \mathrm{Heat}_{y,m} + \mathrm{Cool}_{y,m} + \mathrm{Other}_{y,m} \quad (1)$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$\mathrm{USE}_{m} = a + b_1 \times \mathrm{XHeat}_{m} + b_2 \times \mathrm{XCool}_{m} + b_3 \times \mathrm{XOther}_{m} + \varepsilon_{m} \quad (2)$$

$XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, dwelling data, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

Constructing XHeat

As represented in the SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days
- Heating equipment saturation levels
- Heating equipment operating efficiencies
- Average number of days in the billing cycle for each month
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier:

$$XHeat_{y,m} = HeatIndex_{y,m} \times HeatUse_{y,m} \quad (3)$$

Where:

- $XHeat_{y,m}$ is estimated heating energy use in year (y) and month (m)
- $HeatIndex_{y,m}$ is the monthly index of heating equipment
- $HeatUse_{y,m}$ is the monthly usage multiplier

The heating equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Given a set of fixed weights, the index will change over time with changes in equipment saturations (*Sat*), operating efficiencies (*Eff*), building structural index (*StructuralIndex*), and energy prices. Formally, the equipment index is defined as:

$$HeatIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{15}^{Type} \Big/ Eff_{15}^{Type} \right)} \quad (4)$$

The *StructuralIndex* is constructed by combining the EIA's building shell efficiency index trends with surface area estimates, and then it is indexed to the 2015 value:

$$StructuralIndex_y = \frac{BuildingShellEfficiencyIndex_y \times SurfaceArea_y}{BuildingShellEfficiencyIndex_{15} \times SurfaceArea_{15}} \quad (5)$$

The *StructuralIndex* is defined on the *StructuralVars* tab of the SAE spreadsheets. Surface area is derived to account for roof and wall area of a standard dwelling based on the regional average square footage data obtained from EIA. The relationship between the square footage and surface area is constructed assuming an aspect ratio of 0.75 and an average of 25% two-story and 75% single-story. Given these assumptions, the approximate linear relationship for surface area is:

$$SurfaceArea_y = 892 + 1.44 \times Footage_y \quad (6)$$

In Equation 4, 2015 is used as a base year for normalizing the index. As a result, the ratio on the right is equal to 1.0 in 2015. In other years, it will be greater than 1.0 if equipment saturation levels are above their 2015 level. This will be counteracted by higher efficiency levels, which will drive the index downward. The weights are defined as follows.

$$Weight^{Type} = \frac{Energy_{15}^{Type}}{HH_{15}} \times HeatShare_{15}^{Type} \quad (7)$$

In the SAE spreadsheets, these weights are referred to as *Intensities* and are defined on the *EIAData* tab. With these weights, the *HeatIndex* value in 2015 will be equal to estimated annual heating intensity per household in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

For electric heating equipment, the SAE spreadsheets contain two equipment types: electric resistance furnaces/room units and electric space heating heat pumps. Examples of weights for these two equipment types for the U.S. are given in Table 1.

Table 1: Electric Space Heating Equipment Weights

Equipment Type	Weight (kWh)
Electric Resistance Furnace/Room units	916
Electric Space Heating Heat Pump	377

Data for the equipment saturation and efficiency trends are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for electric space heating heat pumps are given in terms of Heating Seasonal Performance Factor [BTU/Wh], and the efficiencies for electric furnaces and room units are estimated as 100%, which is equivalent to 3.41 BTU/Wh.

Price Impacts. In the 2007 version of the SAE models and thereafter, the Heat Index has been extended to account for the long-run impact of electric and natural gas prices. Since the Heat Index represents changes in the stock of space heating equipment, the price impacts are modeled to play themselves out over a 10-year horizon. To introduce price effects, the Heat Index as defined by

Equation 4 above is multiplied by a 10-year moving-average of electric and gas prices. The level of the price impact is guided by the long-term price elasticities:

$$HeatIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{15}^{Type} \Big/ Eff_{15}^{Type} \right)} \times \left(TenYearMovingAverageElectric\,\mathrm{Price}_{y,m} \right)^{\phi} \times \left(TenYearMovingAverageGas\,\mathrm{Price}_{y,m} \right)^{\gamma} \quad (8)$$

Since the trends in the Structural index (the equipment saturations and efficiency levels) are provided exogenously by the EIA, the price impacts are introduced in a multiplicative form. As a result, the long-run change in the Heat Index represents a combination of adjustments to the structural integrity of new homes, saturations in equipment and efficiency levels relative to what was contained in the base EIA long-term forecast.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, household size, income levels, prices, and billing days. The estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{WgtHDD_{y,m}}{HDD_{15}} \right) \times \left(\frac{HHSize_y}{HHSize_{15}} \right)^{0.25} \times \left(\frac{Income_y}{Income_{15}} \right)^{0.20} \times \left(\frac{Elec\,\mathrm{Price}_{y,m}}{Elec\,\mathrm{Price}_{15,7}} \right)^{\lambda} \times \left(\frac{Gas\,\mathrm{Price}_{y,m}}{Gas\,\mathrm{Price}_{15,7}} \right)^{\kappa} \quad (9)$$

Where:

- *WgtHDD* is the weighted number of heating degree days in year (*y*) and month (*m*). This is constructed as the weighted sum of the current month's HDD and the prior month's HDD. The weights are 75% on the current month and 25% on the prior month.
- *HDD* is the annual heating degree days for 2015
- *HHSize* is average household size in a year (*y*)
- *Income* is average real income per household in year (*y*)
- *ElecPrice* is the average real price of electricity in month (*m*) and year (*y*)
- *GasPrice* is the average real price of natural gas in month (*m*) and year (*y*)

By construction, the $HeatUse_{y,m}$ variable has an annual sum that is close to 1.0 in the base year (2015). The first two terms, which involve billing days and heating degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will reflect changes in the economic drivers, as transformed through the end-use elasticity parameters. The price impacts captured by the Usage equation represent short-term price response.

Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days
- Cooling equipment saturation levels
- Cooling equipment operating efficiencies
- Average number of days in the billing cycle for each month
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$XCool_{y,m} = CoolIndex_{y} \times CoolUse_{y,m} \quad (10)$$

Where

- $XCool_{y,m}$ is estimated cooling energy use in year (y) and month (m)
- $CoolIndex_{y}$ is an index of cooling equipment
- $CoolUse_{y,m}$ is the monthly usage multiplier

As with heating, the cooling equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Formally, the cooling equipment index is defined as:

$$CoolIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{15}^{Type} \Big/ Eff_{15}^{Type} \right)} \quad (11)$$

Data values in 2015 are used as a base year for normalizing the index, and the ratio on the right is equal to 1.0 in 2015. In other years, it will be greater than 1.0 if equipment saturation levels are above their 2015 level. This will be counteracted by higher efficiency levels, which will drive the index downward. The weights are defined as follows.

$$Weight^{Type} = \frac{Energy_{15}^{Type}}{HH_{15}} \times CoolShare_{15}^{Type} \quad (12)$$

In the SAE spreadsheets, these weights are referred to as *Intensities* and are defined on the *EIAData* tab. With these weights, the *CoolIndex* value in 2015 will be equal to estimated annual cooling intensity per household in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

For cooling equipment, the SAE spreadsheets contain three equipment types: central air conditioning, space cooling heat pump, and room air conditioning. Examples of weights for these three equipment types for the U.S. are given in Table 2.

Table 2: Space Cooling Equipment Weights

Equipment Type	Weight (kWh)
Central Air Conditioning	1,036
Space Cooling Heat Pump	522
Room Air Conditioning	277

The equipment saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for space cooling heat pumps and central air conditioning (A/C) units are given in terms of Seasonal Energy Efficiency Ratio [BTU/Wh], and room A/C units efficiencies are given in terms of Energy Efficiency Ratio [BTU/Wh].

Price Impacts. In the 2007 SAE models and thereafter, the Cool Index has been extended to account for changes in electric and natural gas prices. Since the Cool Index represents changes in the stock of space heating equipment, it is anticipated that the impact of prices will be long-term in nature. The Cool Index as defined Equation 11 above is then multiplied by a 10-year moving average of electric and gas prices. The level of the price impact is guided by the long-term price elasticities.

$$CoolIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{15}^{Type} \Big/ Eff_{15}^{Type} \right)} \times \left(TenYearMovingAverageElectric\,\mathrm{Price}_{y,m} \right)^{\phi} \times \left(TenYearMovingAverageGas\,\mathrm{Price}_{y,m} \right)^{\gamma} \quad (13)$$

Since the trends in the Structural index, equipment saturations and efficiency levels are provided exogenously by the EIA, price impacts are introduced in a multiplicative form. The long-run change in the Cool Index represents a combination of adjustments to the structural integrity of new homes, saturations in equipment and efficiency levels. Without a detailed end-use model, it is not possible to isolate the price impact on any one of these concepts.

Cooling system usage levels are impacted monthly by several factors, including weather, household size, income levels, and prices. The estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{WgtCDD_{y,m}}{CDD_{15}} \right) \times \left(\frac{HHSize_y}{HHSize_{15}} \right)^{0.25} \times \left(\frac{Income_y}{Income_{15}} \right)^{0.20} \times \left(\frac{Elec\,\mathrm{Price}_{y,m}}{Elec\,\mathrm{Price}_{15}} \right)^{\lambda} \times \left(\frac{Gas\,\mathrm{Price}_{y,m}}{Gas\,\mathrm{Price}_{15}} \right)^{\kappa} \quad (14)$$

Where:

- *WgtCDD* is the weighted number of cooling degree days in year (*y*) and month (*m*). This is constructed as the weighted sum of the current month's CDD and the prior month's CDD. The weights are 75% on the current month and 25% on the prior month.
- *CDD* is the annual cooling degree days for 2015.

By construction, the *CoolUse* variable has an annual sum that is close to 1.0 in the base year (2015). The first two terms, which involve billing days and cooling degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will change to reflect changes in the economic driver changes.

Constructing XOther

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Appliance and equipment saturation levels
- Appliance efficiency levels
- Average number of days in the billing cycle for each month
- Average household size, real income, and real prices

The explanatory variable for other uses is defined as follows:

$$XOther_{y,m} = OtherEqpIndex_{y,m} \times OtherUse_{y,m} \tag{15}$$

The first term on the right-hand side of this expression ($OtherEqpIndex_y$) embodies information about appliance saturation and efficiency levels and monthly usage multipliers. The second term (*OtherUse*) captures the impact of changes in prices, income, household size, and number of billing-days on appliance utilization.

End-use indices are constructed in the SAE models. A separate end-use index is constructed for each end-use equipment type using the following function form.

$$ApplianceIndex_{y,m} = Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ \frac{1}{UEC_y^{Type}} \right)}{\left(Sat_{15}^{Type} \Big/ \frac{1}{UEC_{15}^{Type}} \right)} \times MoMult_m^{Type} \times \left(TenYearMovingAverageElectric\,\mathrm{Price}\right)^{\lambda} \times \left(TenYearMovingAverageGas\,\mathrm{Price}\right)^{\kappa} \tag{16}$$

Where:

- *Weight* is the weight for each appliance type
- *Sat* represents the fraction of households, who own an appliance type
- $MoMult_m$ is a monthly multiplier for the appliance type in month (m)
- *Eff* is the average operating efficiency the appliance
- *UEC* is the unit energy consumption for appliances

This index combines information about trends in saturation levels and efficiency levels for the main appliance categories with monthly multipliers for lighting, water heating, and refrigeration.

The appliance saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets.

Further monthly variation is introduced by multiplying by usage factors that cut across all end uses, constructed as follows:

$$ApplianceUse_{y,m} = \left(\frac{BDays_{y,m}}{30.44}\right) \times \left(\frac{HHSize_y}{HHSize_{15}}\right)^{0.46} \times \left(\frac{Income_y}{Income_{15}}\right)^{0.10} \times \left(\frac{Elec\,\mathrm{Pr}\,ice_{y,m}}{Elec\,\mathrm{Pr}\,ice_{15}}\right)^{\phi} \times \left(\frac{Gas\,\mathrm{Pr}\,ice_{y,m}}{Gas\,\mathrm{Pr}\,ice_{15}}\right)^{\lambda} \quad (17)$$

The index for other uses is derived then by summing across the appliances:

$$OtherEqpIndex_{y,m} = \sum_k ApplianceIndex_{y,m} \times ApplianceUse_{y,m} \quad (18)$$

Supporting Spreadsheets and MetrixND Project Files

The SAE approach described above has been implemented for each of the nine Census Divisions. A mapping of states to Census Divisions is presented in Figure 16. This section describes the contents of each file and a procedure for customizing the files for specific utility data. A total of 18 files are provided. These files are listed in Table 3.

Figure 16: Mapping of States to Census Divisions

Table 3: List of SAE Files

Spreadsheet	*MetrixND* Project File
NewEngland.xls	SAE_NewEngland.ndm
MiddleAtlantic.xls	SAE_MiddleAtlantic.ndm
EastNorthCentral.xls	SAE_EastNorthCentral.ndm
WestNorthCentral.xls	SAE_WestNorthCentral.ndm
SouthAtlantic.xls	SAE_SouthAltantic.ndm
EastSouthCentral.xls	SAE_EastSouthCentral.ndm
WestSouthCentral.xls	SAE_WestSouthCentral.ndm
Mountain.xls	SAE_Mountain.ndm
Pacific.xls	SAE_Pacific.ndm

As defaults, the SAE spreadsheets include regional data, but utility data can be entered to generate the *Heat*, *Cool*, and *Other* equipment indices used in the SAE approach. The *MetrixND* project files link to the data in these spreadsheets. These project files calcualte the end-use *Usage* variables are constructed and the estimated SAE models.

Each of the nine SAE spreadsheets contains the following tabs:

- **Definitions -** Contains equipment, end use, worksheet, and Census Division definitions.
- **Intensities -** Calculates the annual equipment indices.
- **Shares -** Contains historical and forecasted equipment shares. The default forecasted values are provided by the EIA. The raw EIA projections are provided on the *EIAData* tab.
- **Efficiencies -** Contains historical and forecasted equipment efficiency trends. The forecasted values are based on projections provided by the EIA. The raw EIA projections are provided on the *EIAData* tab.
- **StructuralVars -** Contains historical and forecasted square footage, number of households, building shell efficiency index, and calculation of structural variable. The forecasted values are based on projections provided by the EIA.
- **Calibration -** This tab contains calculations of the base year *Intensity* values used to weight the equipment indices.
- **EIAData -** Contains the raw forecasted data provided by the EIA.
- **MonthlyMults -** Contains monthly multipliers that are used to spread the annual equipment indices across the months.
- **EV -** Worksheet for incorporating electric vehicle (EV) impacts.
- **PV -** Worksheet for incorporating photovoltaic battery (PV) impacts.

The *MetrixND* Project files are linked to the *AnnualIndices*, *ShareUEC*, and *MonthlyMults* tabs in the spreadsheets. Sales, economic, price and weather information for the Census Division is provided in the linkless data table *UtilityData*. In this way, utility specific data and the equipment indices are brought into the project file. The *MetrixND* project files contain the objects described below.

Parameter Tables

- **Elas.** This parameter table includes the values of the elasticities used to calculate the *Usage* variables for each end-use. There are five types of elasticities included on this table.

  - Economic variable elasticities
  - Short-term own price elasticities
  - Short-term cross price elasticities
  - Long-term own price elasticities

- Long-term cross price elasticities

The short-term price elasticities drive the end-use usage equations. The long-term price elasticities drive the Heat, Cool and other appliance indices. The combined price impact is an aggregation of the short and long-term price elasticities. As such, the long-term price elasticities are input as incremental price impact. That is, the long-term price elasticity is the difference between the overall price impact and the short-term price elasticity.

Data Tables

- **AnnualEquipmentIndices** links to the *AnnualIndices* tab for heating and cooling indices, and *ShareUEC* tab for water heating, lighting, and appliances in the SAE spreadsheet.
- **UtilityData** is a linkless data table that contains sales, price, economic and weather data specific to a given Census Division.
- **MonthlyMults** links to the corresponding tab in the SAE spreadsheet.

Transformation Tables

- **EconTrans** computes the average usage, and household size, household income, and price indices used in the usage equations.
- **WeatherTrans** computes the HDD and CDD indices used in the usage equations.
- **ResidentialVars** computes the *Heat*, *Cool* and *Other Usage* variables, as well as the *XHeat*, *XCool* and *XOther* variables that are used in the regression model.
- **BinaryVars** computes the calendar binary variables that could be required in the regression model.
- **AnnualFcst** computes the annual historical and forecast sales and annual change in sales.
- **EndUseFcst** computes the monthly sales forecasts by end uses.

Models

- **ResModel** is the Statistically Adjusted End-Use Model.

Steps to Customize the Files for Your Service Territory

The files that are distributed along with this document contain regional data. If you have more accurate data for your service territory, you are encouraged to tailor the spreadsheets with that information. This section describes the steps needed to customize the files.

Minimum Customization

- Save the *MetrixND* project file and the spreadsheet into the same folder
- Select the spreadsheet and *MetrixND* project file from the appropriate Census Division

- Open the spreadsheet and navigate to the *Calibration* tab
- In cell "B9", replace base year Census Division use-per-customer with observed use-per-customer for your service territory
- Save the spreadsheet and open the *MetrixND* project file
- Click on the *Update All Links* button on the *Menu* bar
- Review the model results

Further Customization of Starting Usage Levels

In addition to the minimum steps listed above, you can also utilize model-based calibration process described above on pages 15-16 to further fine-tune starting year usage estimates to your service territory.

Customizing the End-use Share Paths

You can also install your own share history and forecasts. To do this, navigate to the *Share* tab in the spreadsheet and paste in the values for your region. Make sure that base year shares on the *Calibration* tab reflect changes on the *Shares* tab.

Customizing the End-use Efficiency Paths

Finally, you can override the end-use efficiency paths that are contained on the *Efficiencies* tab of the spreadsheet.

LF-8

NVEnergy

ECONOMIC OVERVIEW & DEVELOPMENT PIPELINE

2024

APPLIED ANALYSIS

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April 1, 2024

Ms. Janet Wells
Vice President, Regulatory
NVEnergy
6226 West Sahara Avenue
Las Vegas, Nevada 89146

RE: NV Energy | Economic Overview & Development Pipeline

Dear Ms. Wells:

In accordance with your request, Applied Analysis ("AA") is pleased to submit this summary report, *Economic Overview & Development Pipeline*. AA was retained by NV Energy to assist in evaluating the general economic growth indicators statewide as well as in the Southern Nevada and Northern Nevada regions. This summary report outlines the salient findings and conclusions of our review and analysis regarding the labor market, income and spending, tourism, the housing market, population, migration and the development pipeline.

This report was designed by AA in response to your request. However, we make no representations as to the adequacy of these procedures for all your purposes. Generally speaking, our findings and estimates are as of the date of this report and utilize the most recent data publicly available. The information in this report was collected from our internal databases and various third parties and other public data providers. The data were assembled by AA. While we have no reason to doubt its accuracy, the information collected was not subjected to any auditing or review procedures by AA; therefore, we can offer no representations or assurances as to its completeness. This report is an executive summary. It is intended to provide an overview of the analyses conducted and a summary of our salient findings. AA will retain additional working papers relevant to this study. If you reproduce this report, it must be done so in its entirety. We welcome the opportunity to discuss this report with you at any time. Should you have any questions, please contact Jeremy Aguero or Brian Gordon at (702) 967-3333.

Sincerely,

Applied Analysis

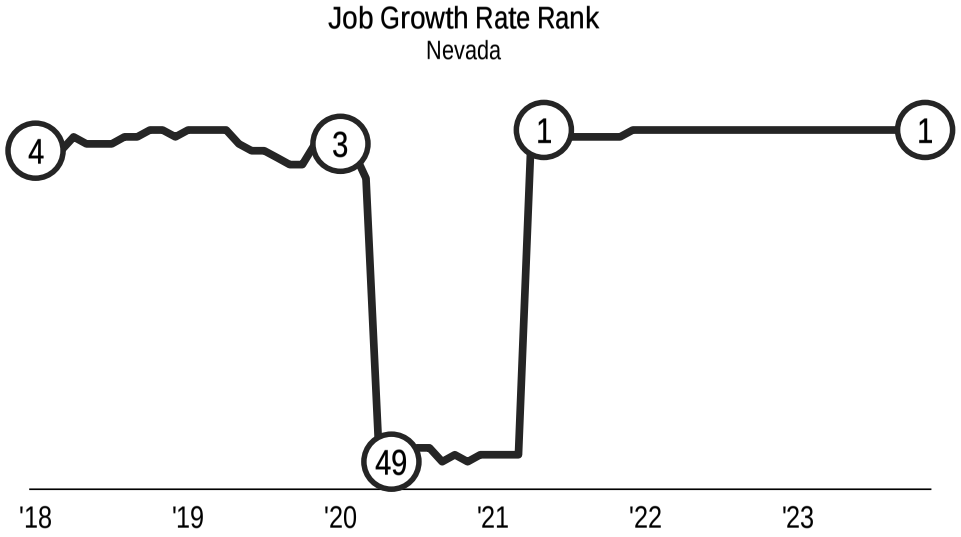
Applied Analysis

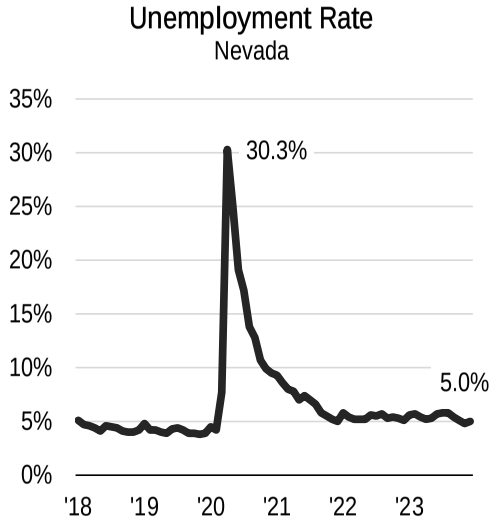
Employment

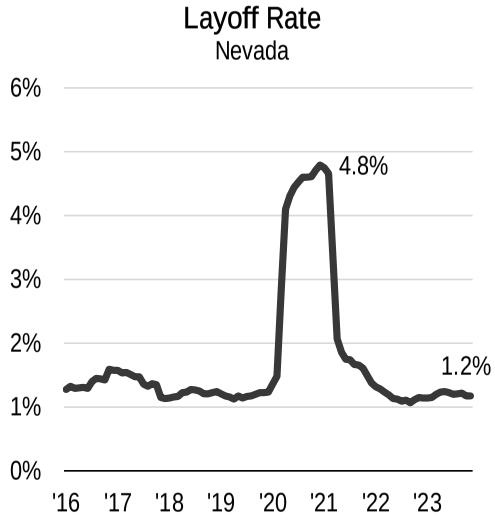
After being hit harder than the rest of the nation during the pandemic, Nevada employment emerged from the crisis even stronger than before. Since April 2021, the state has ranked first or second in annual job growth rate each month through the end of 2023, including a stretch of 25 straight months with the fastest job growth in the United States. Nevada's job growth rate since February 2020 was the second-highest in the nation, even after accounting for the significant pandemic-related job losses. Statewide trends have been largely driven by Southern Nevada. Among the 30 largest metropolitan areas, Southern Nevada's employment growth since April 2021 has ranked among the top three in every month, including 21 months ranked first.

Labor Market

Unemployment rates across Nevada have improved considerably since their pandemic-related highs. They remain slightly elevated compared to pre-pandemic levels, though that is largely a function of an expanding labor force rather than layoffs. Nevada's labor force (e.g., the number of people who have a job combined with those who are actively looking for work) expanded by 3.5 percent over the past year, the fourth-fastest growth rate in the nation. Other metrics of the labor force, including the hiring rate, the layoff rate and the quit rate, have all returned to pre-2020 levels as the labor market has stabilized following the period of pandemic-related disruptions.

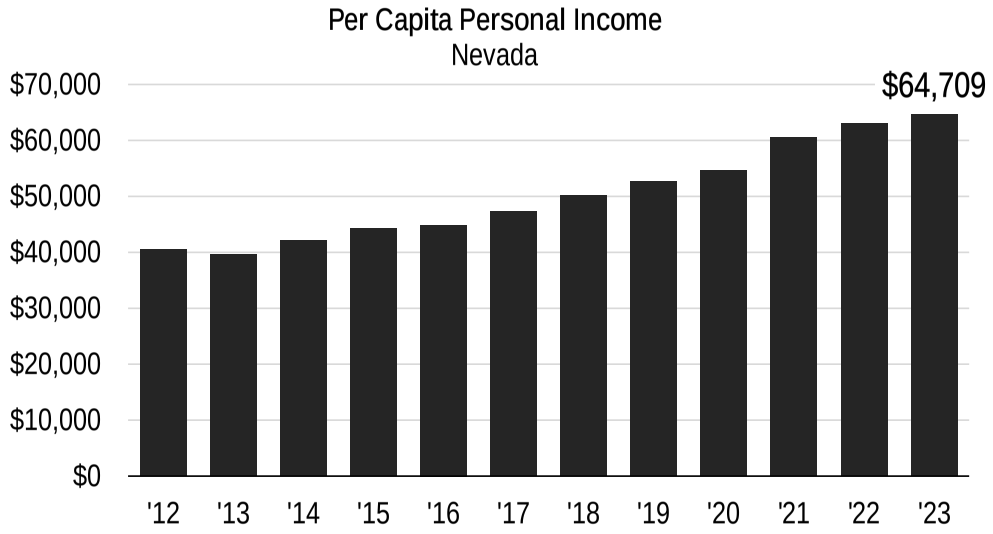






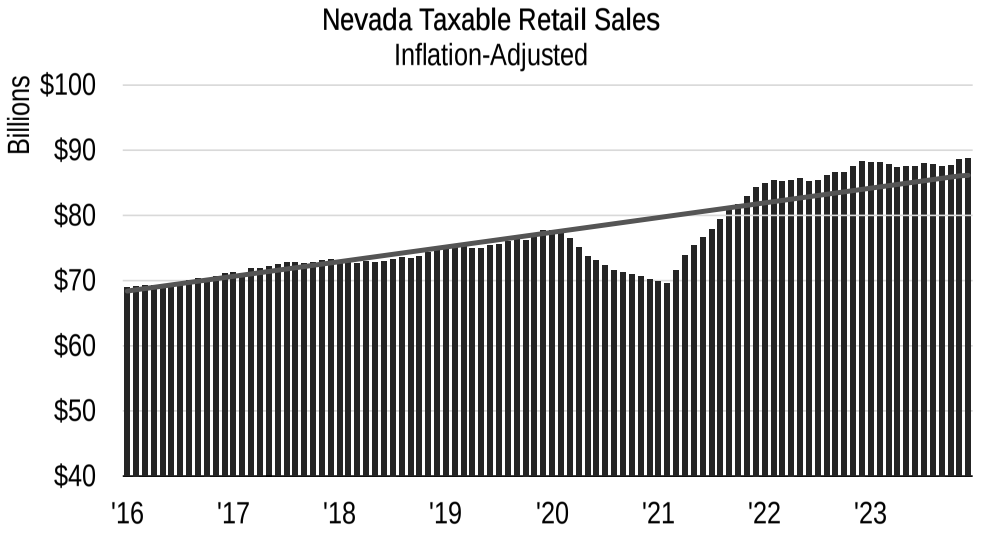
Wages and Income

At different points after the pandemic, wage growth accelerated as demand for workers climbed amid the fast-emerging economy and inflation climbed to four-decade highs. Annual growth in average weekly wages in Nevada surged through 2022, peaking at 7.3 percent amid a tight labor market. That trend reversed in 2023 as the labor market normalized. Statewide annual wage growth closed the year at 2.0 percent. Regional annual wage growth varied greatly, with Northern Nevada's rate of 9.9 percent coming in 10 times higher than Southern Nevada's 0.9 percent. Personal income per capita surged in recent years as federal stimulus, rising wages and investment growth combined to boost household wealth. Annual growth in per capita income peaked in 2021 at 10.8 percent. It has since slowed to 2.7 percent (through the third quarter of 2023), the lowest level since 2016.



Consumer Spending

Consumer spending in Nevada remained steady through 2023. Statewide taxable retail sales grew 4.2 percent in 2023 to a record $88.7 billion. Outside of the pandemic era, that was the slowest annual growth rate since 2010. Total retail sales in both Southern Nevada and Northern Nevada also set annual records while growing by 4.4 percent and 1.5 percent, respectively, on the year. In Southern Nevada, the pandemic-related decline in taxable sales was deeper compared to Northern Nevada, and its post-pandemic growth hit a higher peak. Northern Nevada retail sales suffered minimal pandemic-related impacts. However, its post-pandemic growth has been more tempered, especially through 2023. After adjusting for the years of heated inflation, statewide retail sales have held steadily above the long-term trend, though the gap has been narrowing as consumer spending slows.



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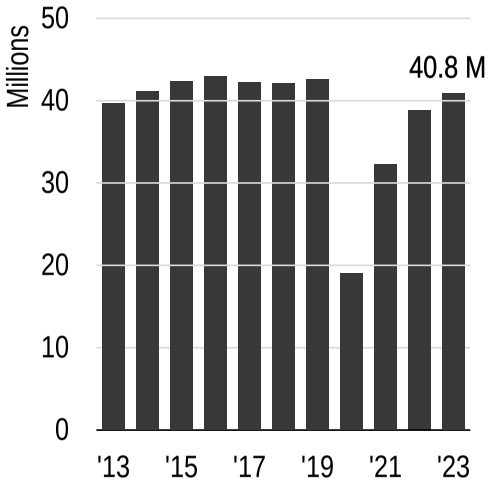
Tourism

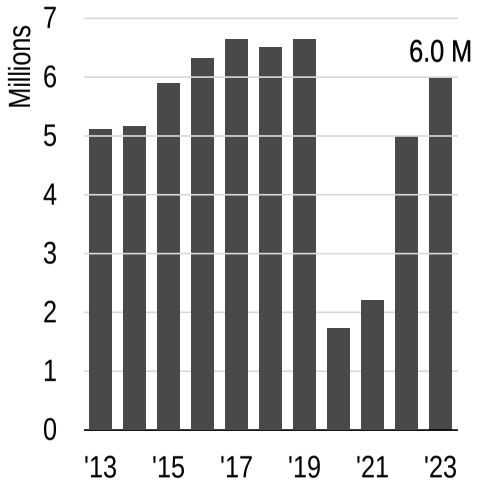
Visitor volume in Southern Nevada continued to recover through 2023, rising 3.3 percent on the year to reach 40.8 million, and convention attendance bounced back to just over 6 million for the first time since the pandemic. The continued recovery of the convention and international segments will be key for a return to pre-pandemic visitation levels in Southern Nevada. In Northern Nevada, visitor volume has recovered some since the pandemic, and while it has not returned to prior levels, it ended the steady decline heading into 2020. In both regions, gaming revenue set record highs in 2023 as statewide revenue reached an all-time high of $15.5 billion.

Southern Nevada's post-pandemic tourism rebound was aided by significant private and public investments in new venues in recent years. Allegiant Stadium, the Sphere and the Formula 1 pit building each hosted major sports and entertainment events in 2023, driving visitation and helping room rates surge to new highs due to high-demand events such as the Formula 1 Las Vegas Grand Prix and concerts by Taylor Swift and Beyonce. The stadium hosted Super Bowl LVIII in 2024 and will host the NCAA men's basketball Final Four in 2027. Meanwhile, the Oakland A's baseball team will relocate in 2028. Their new stadium on the Las Vegas Strip will add to the foundation of sports and entertainment venues that is ushering in the latest phase of Las Vegas's ever-evolving tourism landscape.

Las Vegas Visitor Volume



Convention Attendance

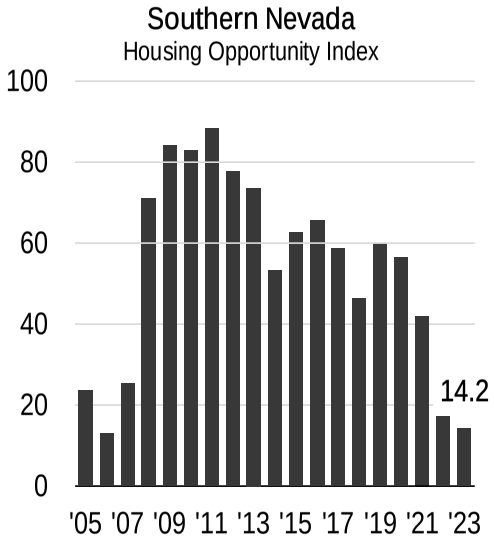


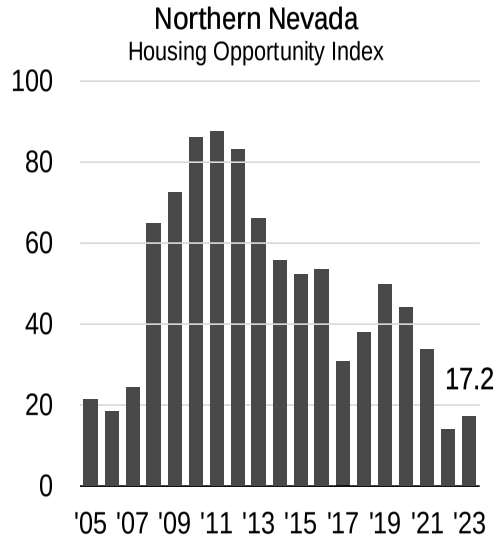
Venue Development	
T-Mobile Arena (2016)	Home of the Vegas Golden Knights and host of dozens of premier events
Allegiant Stadium (2020)	Home of the Las Vegas Raiders and host of large-scale music concerts and sporting events
Sphere (2023)	One-of-a-kind music venue hailed for its immersive audio and visual experience
Formula 1 Pit Building (2023)	Hub for the Las Vegas Grand Prix race through the Las Vegas Strip corridor
Las Vegas A's Stadium (2028)	New home for the Major League Baseball team relocating from Oakland, CA.

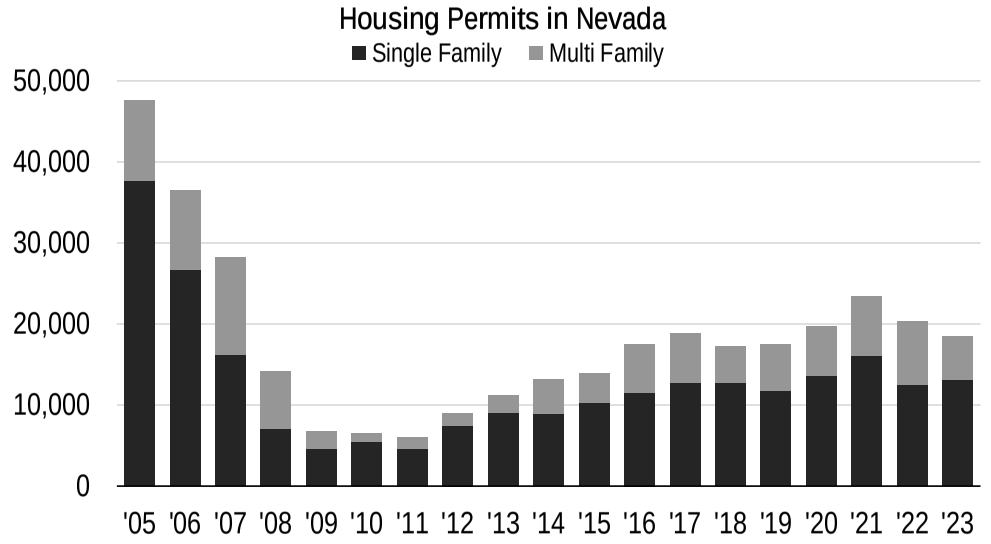
Housing Market

Resale home prices in Nevada spiked in the years after the pandemic began amid rising demand and historically low interest rates. The period of rapid price increases cooled in 2023 as mortgage rates climbed and demand slowed. Total resale closings for both single-family homes and condos or townhouses hit low points in 2023, a drop that coincided with a collapse in new listings. More than 60 percent of Nevada mortgage holders locked in interest rates under 4 percent in recent years, creating a lock-in effect as rates climbed over 7 percent.

Although home prices moderated in 2023, the multi-year period has been marked as one of homes becoming less affordable throughout Nevada due to a combination of higher pricing and higher borrowing costs. The Housing Opportunity Index for both Southern Nevada and Northern Nevada ended 2023 near historical lows that haven't been reached in more than 15 years. The addition of new homes and apartments to the market can help address the supply side of the supply-demand dynamic in housing costs. Single family homebuilding in Nevada spiked in 2021 during the post-pandemic pricing surge. It has since leveled off at about 13,000 annual units, similar to pre-2020 levels. Building activity for multi-family units, including apartments, has been on an upswing over the past few years, particularly in Northern Nevada. In the region, more multi-family units have been permitted than single family homes in three of the past five years, something that only happened twice over the prior 14 years.







APPLIED ANALYSIS

Population Growth

State population has steadily grown over the past two decades, reaching an all-time high of 3.2 million in 2023. Nevada has been one of the fastest growing states in the nation during that period, though economic disruptions have curtailed growth at times. Over the past decade, the Silver State had the fifth-fastest population growth in the nation, while Southern Nevada and Northern Nevada ranked eighth and second, respectively, among peer metropolitan areas.

Since the pandemic year of 2020, population growth across Nevada has slowed significantly, according to U.S. Census Bureau estimates. In 2023, population growth for the state and its major population centers fell to about a half percent, and their respective rankings fell, as well.

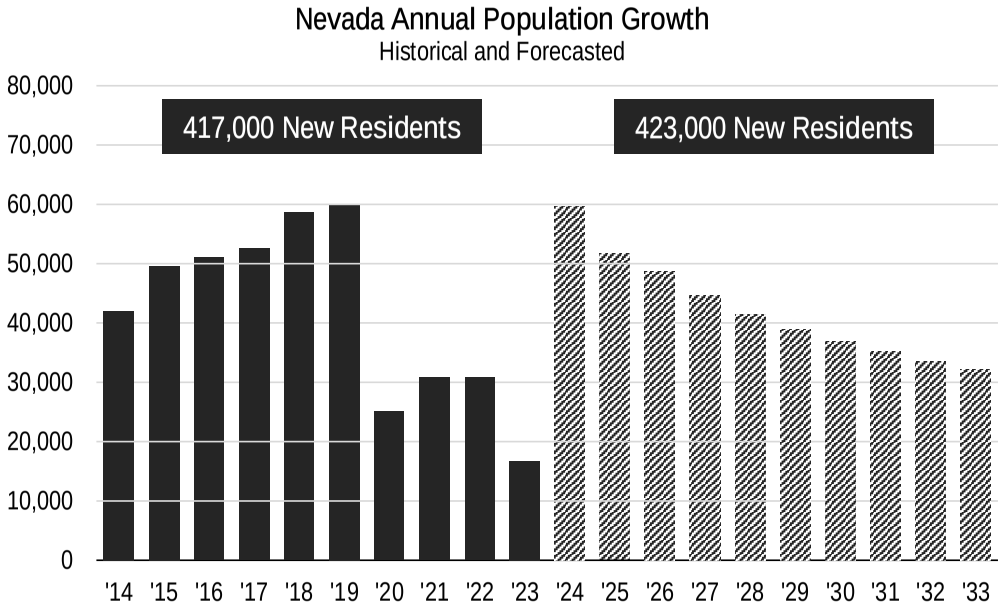
On a year-by-year basis, population growth in Southern Nevada and Northern Nevada experienced varying trends in recent years. In the south, population grew by 0.4 percent in 2020 and grew over the next two years to a peak of 1.2 percent in 2022 before dipping in the latest year. In Northern Nevada, population spiked in 2020 as incoming residents relocated to the region from California and elsewhere amid rising work-from-home opportunities. Population growth slowed from that peak to the 0.4 percent in 2023.

While Census Bureau figures show slowing population growth in Nevada, other measures, including employment and electric meter connections, suggest that population in the state, especially in Southern Nevada, have continued to grow at an annual rate of about 1.5 percent. The number of driver's license surrenders in Clark County, however, has declined for two straight years to the lowest point since 2015 (excluding 2020).

Current projections from the Nevada State Demographer call for state population to expand by a compound annual rate of 1.3 percent over the next 10 years, adding 423,000 residents. That growth would be consistent with the past decade, when the state added 417,000 residents for a compound annual growth rate of 1.4 percent.

Population Growth Rank vs. Comparable Geographies

	1-Year Growth	Rank	10-Year Growth	Rank
Nevada	0.5%	19	13.1%	5
Southern Nevada	0.6%	13	15.8%	8
Northern Nevada	0.4%	21	25.3%	2



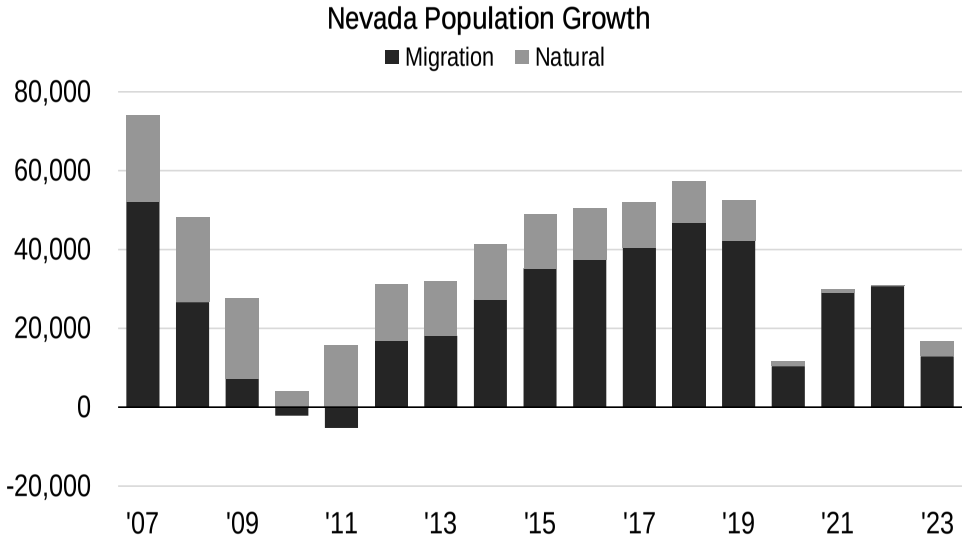
APPLIED ANALYSIS

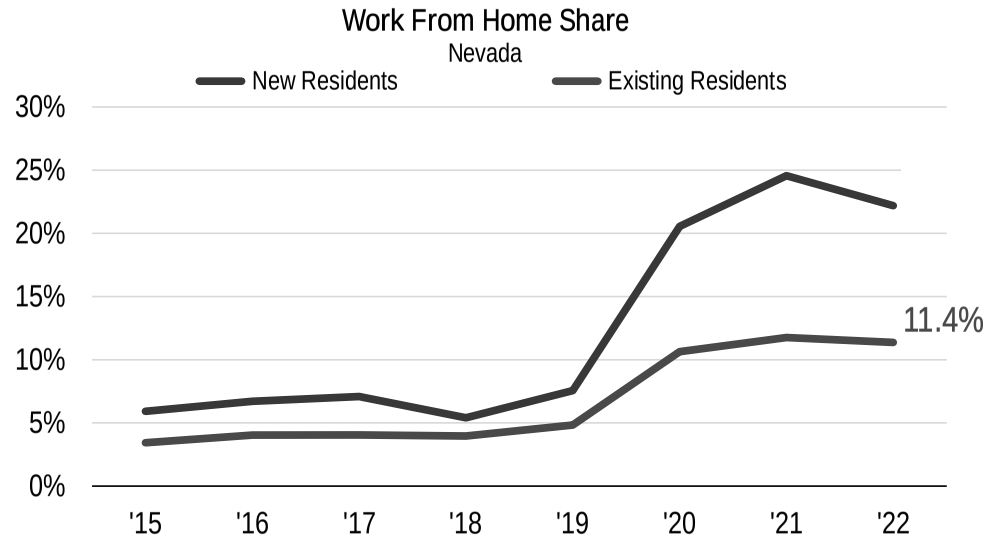
Migration

New residents moving into Nevada have long been the primary source of population growth in the state. Over the past two decades, incoming residents have accounted for about three-quarters of the state's population growth. California has been the primary source of incoming residents to the state, accounting for a third of all new residents since 2005. No other state accounted for more than 5 percent of new residents. For Southern Nevada, California (32.1 percent), Arizona (5.2 percent) and Texas (3.9 percent) provided the most incoming residents. In Northern Nevada, the top three states of origin were California (43.8 percent), Texas (4.3 percent) and Washington (3.9 percent).

Nevada's lower relative cost of living, including housing, compared to nearby metropolitan areas consistently makes the Silver State an attractive destination for relocating residents. In recent years, the growth of remote work since the pandemic made Nevada a viable destination for residents moving away from more expensive areas while keeping their jobs. Since 2020, incoming residents have been twice as likely to work from home than residents already in Nevada.

The lack of a state income tax and a favorable business climate, especially compared to neighboring California, have also traditionally been a strong motivator for business relocations to Nevada. The Silver State consistently ranks among the top 10 in the Tax Foundation's annual Business Tax Climate rankings.



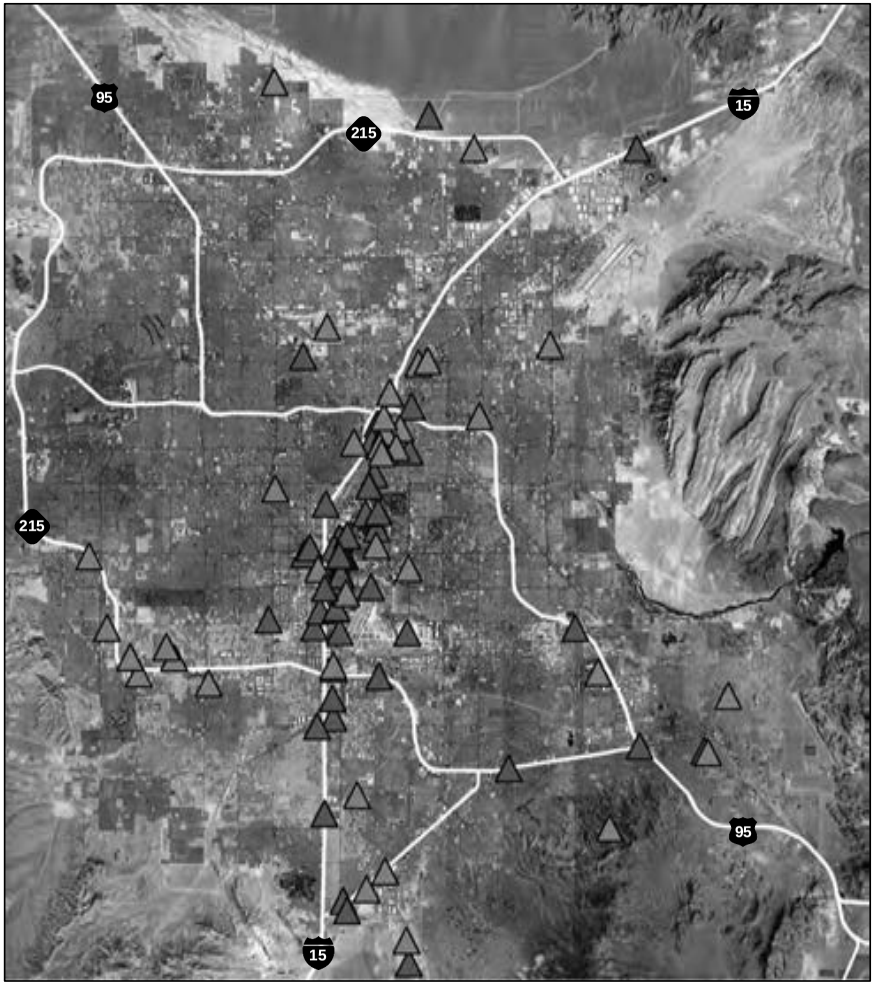


APPLIED ANALYSIS

Southern Nevada Development Pipeline

Between 2020 and 2023, more than $22 billion in major project investments were completed throughout the region. Notable projects included Allegiant Stadium, Resorts World Las Vegas, Fontainebleau and the Sphere. In the years ahead, the development pipeline includes investments totaling more than $31 billion across tourism ($16.9 billion), non-tourism ($10.2 billion) and transportation ($4.1 billion). These investments will be key drivers for future economic growth, diversifying the pool of amenities within the region and improving infrastructure. The investments listed in this report reflect large singular projects. A significant amount of investment in numerous residential and commercial developments is not included here.

PROJECT STATUS	TOTAL PROJECTS	TOTAL VALUE
Under Construction	43	$10.9 Billion
▲ Tourism	17	$3.6 Billion
▲ Non-Tourism	20	$6.7 Billion
▲ Transportation	6	$622.3 Million
Planned	44	$20.3 Billion
▲ Tourism	22	$13.3 Billion
▲ Non-Tourism	17	$3.4 Billion
▲ Transportation	5	$3.6 Billion
Total	87	$31.2 Billion

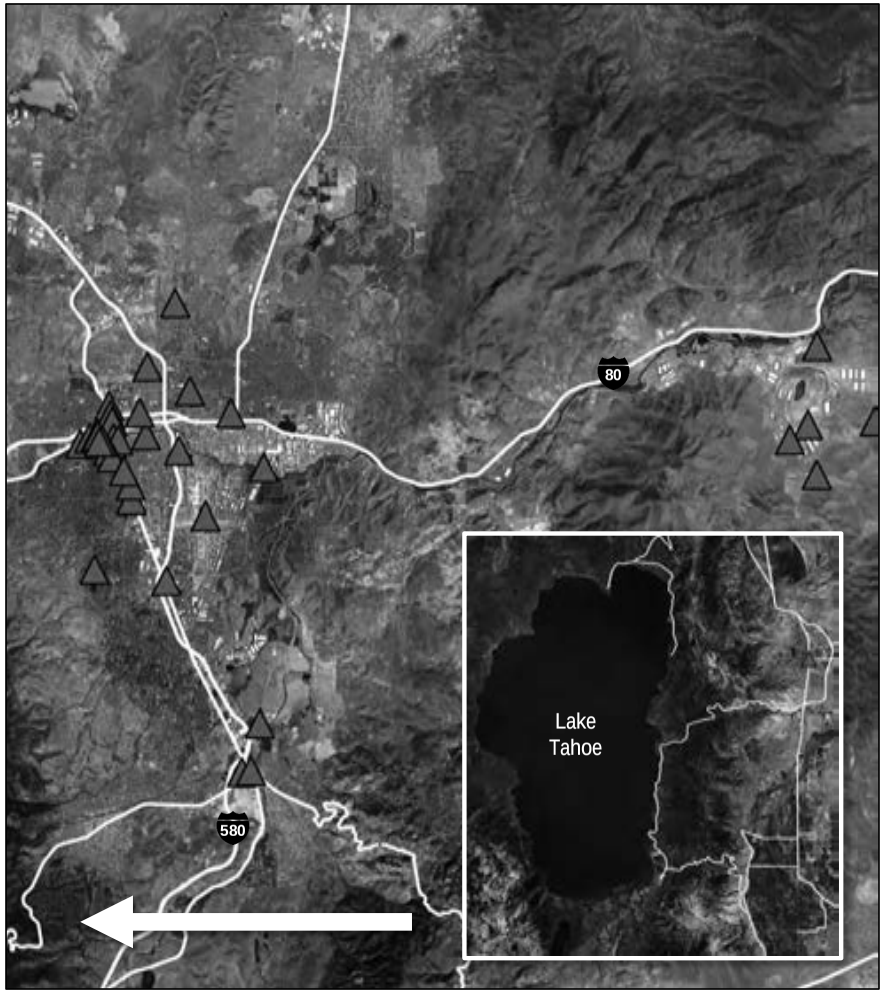


APPLIED ANALYSIS

Northern Nevada Development Pipeline

Between 2019 and 2023, Northern Nevada completed more than $8 billion in major project investments. Notable projects included the Tesla Gigafactory, a Google data center and Northern Nevada Medical Center. The development pipeline includes projects totaling more than $9.2 billion, comprising $7.1 billion in privately funded project and $2.1 billion in publicly funded projects. This list of ongoing and future projects includes the Redwood Materials Battery Recycling Facility, the expansion of the Tesla Gigafactory and the expansion and renovation of Grand Sierra Resort.

PROJECT STATUS	TOTAL PROJECTS	TOTAL VALUE
Under Construction	24	$4.1 Billion
▲ Privately Funded	17	$2.4 Billion
▲ Publicly Funded	7	$1.7 Billion
Planned	17	$5.1 Billion
▲ Privately Funded	11	$4.6 Billion
▲ Publicly Funded	6	$427.3 Million
Total	41	$9.2 Billion



- LABOR MARKET
- INCOME AND SPENDING
- TOURISM
- HOUSING MARKET
- POPULATION AND MIGRATION
- DEVELOPMENT PIPELINE

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

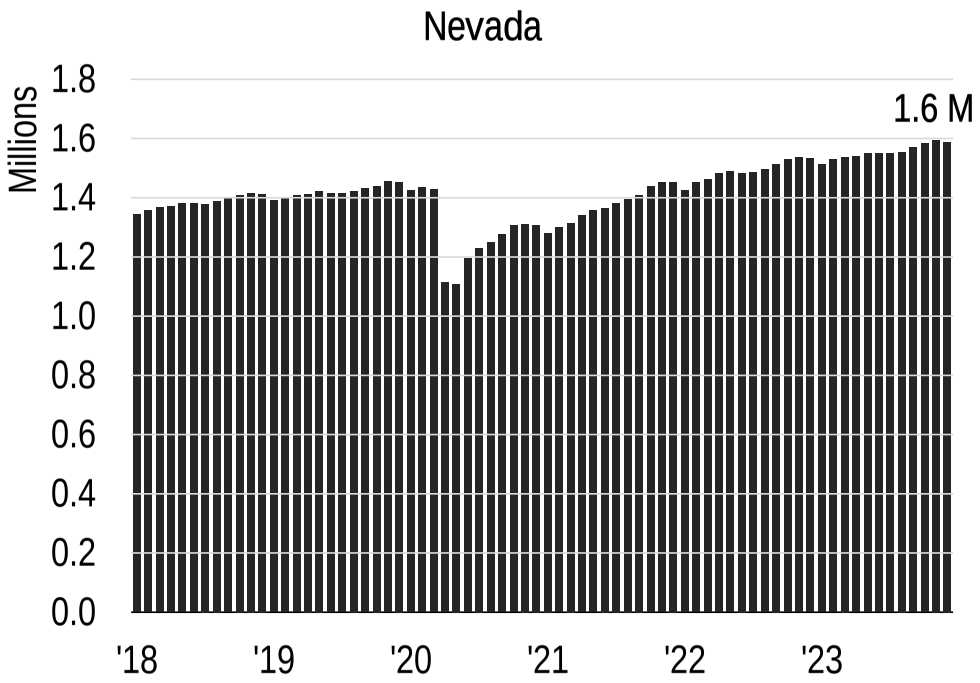
POPULATION AND MIGRATION

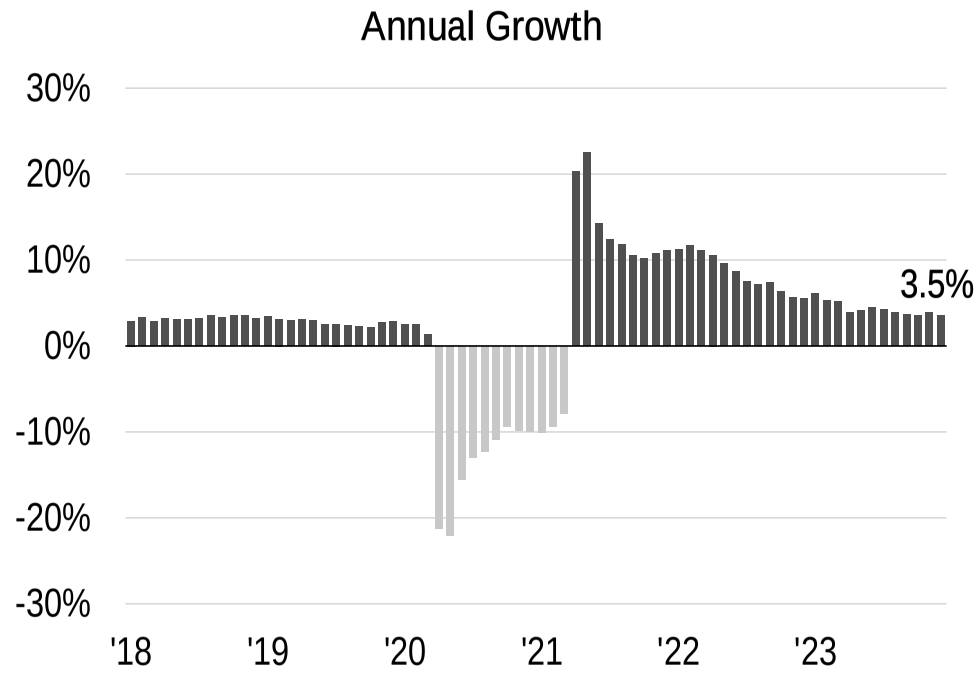
DEVELOPMENT PIPELINE

Employment

Nevada

Statewide employment reached an all-time high of 1.6 million at the end of 2023. For the year, Nevada's 3.5 percent year-over-year job growth rate ranked first in the nation.

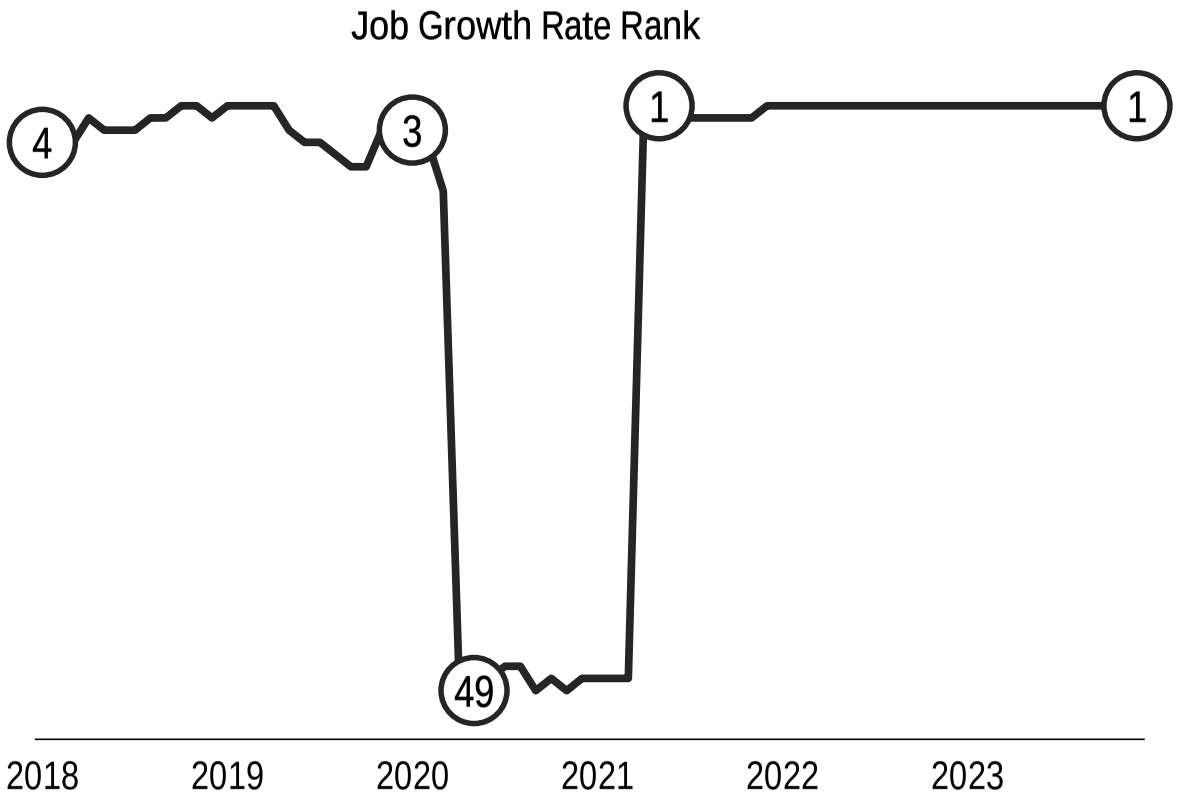




Source: U.S. Bureau of Labor Statistics

Employment Growth Rank

Nevada



Source: U.S. Bureau of Labor Statistics, Applied Analysis

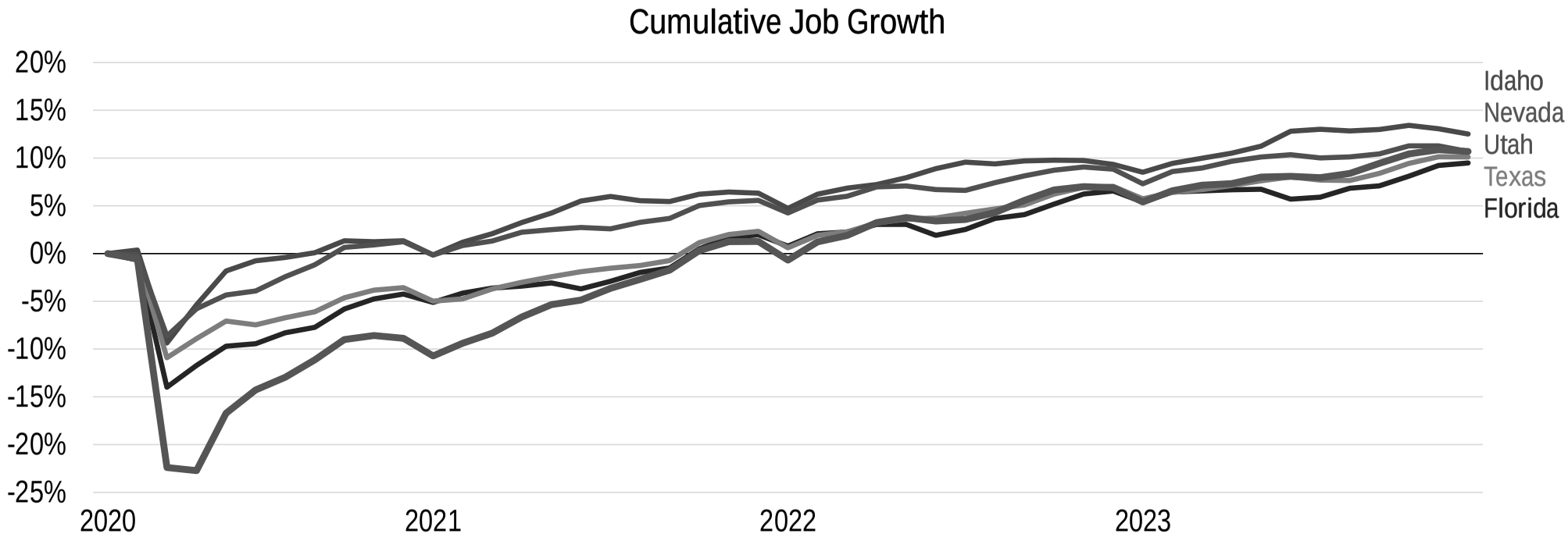
Employment growth in Nevada plummeted when the pandemic struck, but the state emerged from the crisis even stronger.

Since April 2021, the state has ranked first or second in annual job growth rate each month, including a stretch of 25 straight months with the fastest job growth in the United States.

Employment Growth

Nevada

The state's employment rebound is more than a recovery of lost jobs. Even after accounting for pandemic-related job losses, Nevada's cumulative job growth of 10.7 percent since February 2020 tied for second in the nation.

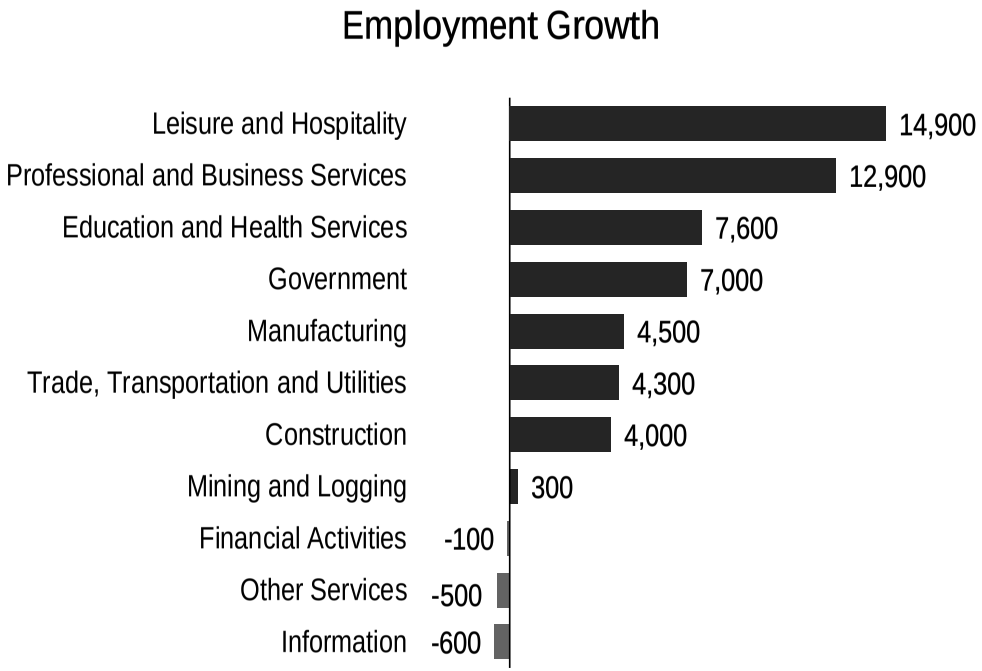


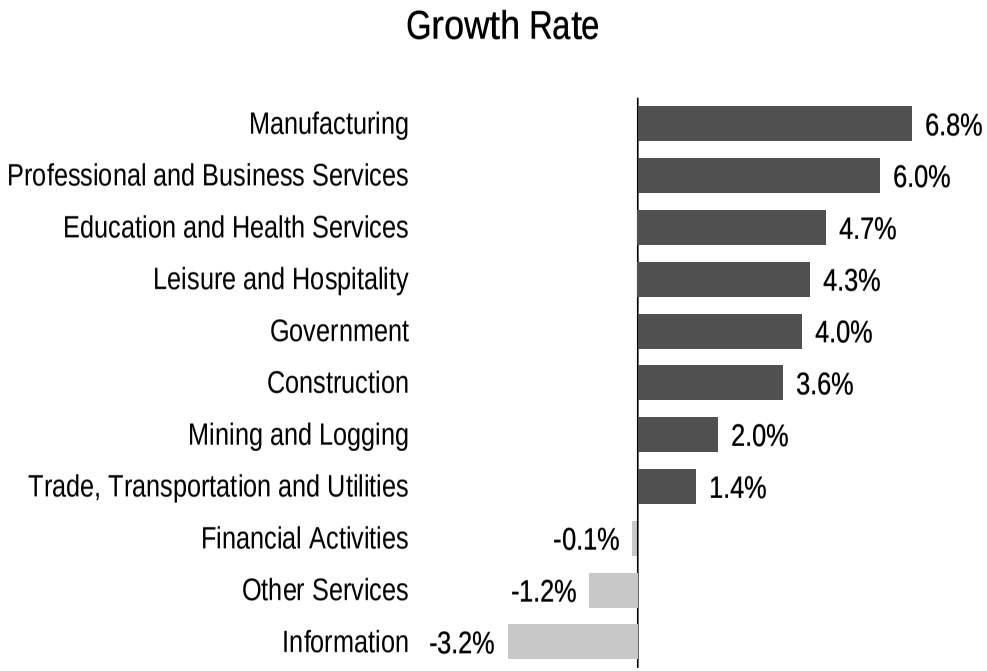
Source: U.S. Bureau of Labor Statistics, Applied Analysis

Employment Growth

Nevada | December 2022 vs. December 2023

Statewide employment growth through 2023 was broad-based, with most major industry sectors reporting notable expansions.



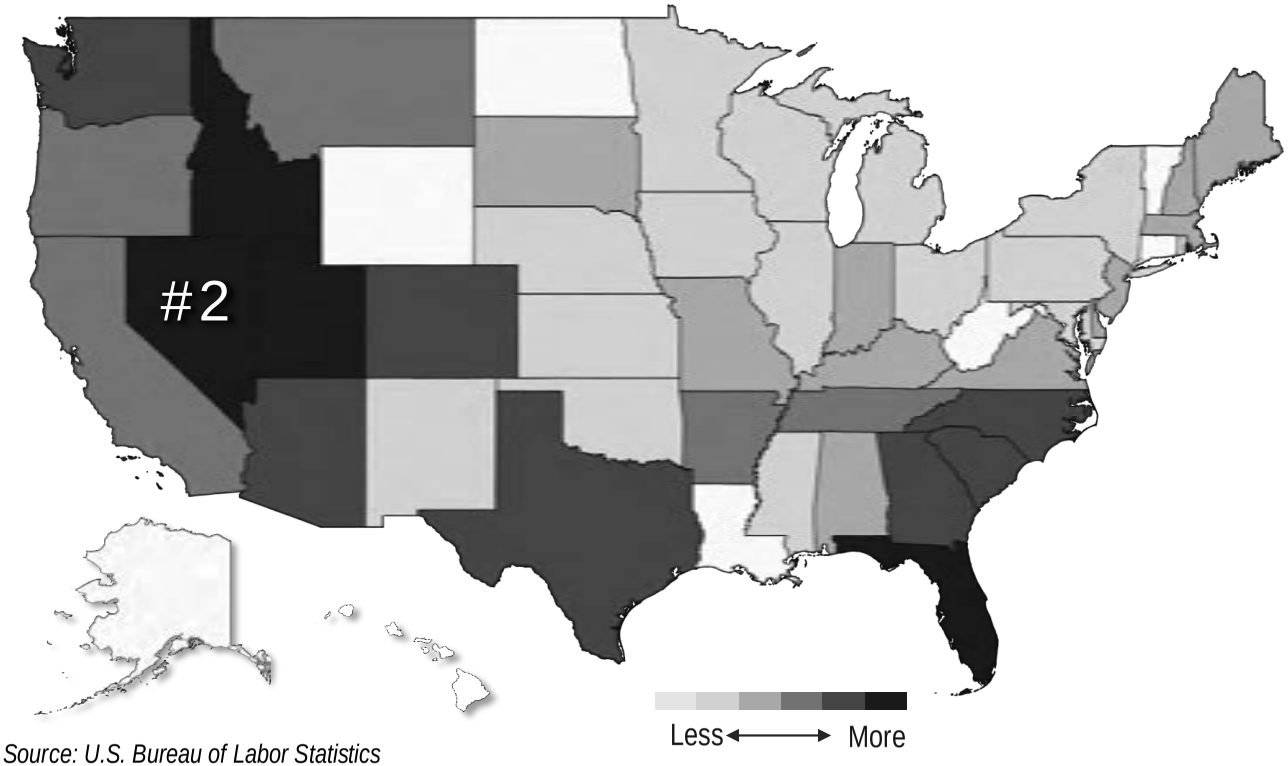


Source: U.S. Bureau of Labor Statistics

Employment Growth by State

December 2013 vs. December 2023

Over the past decade, job growth in Nevada was the second-fastest in the United States at nearly 33 percent. That rate was three times the national average of 11 percent.



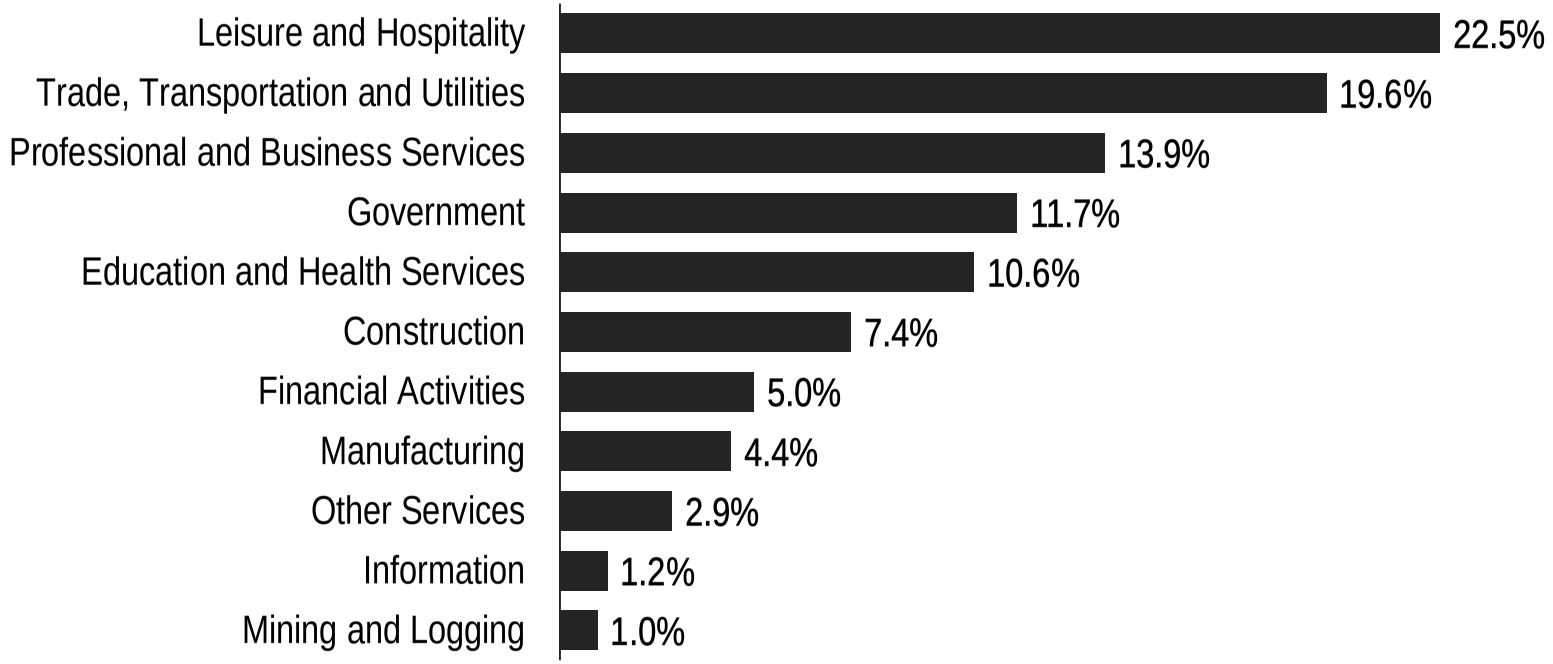
RANK	STATE	GROWTH
1	Idaho	33.1%
2	NEVADA	32.8%
3	Utah	31.1%
4	Florida	28.1%
5	Arizona	24.9%
6	Texas	24.2%
7	Georgia	21.7%
8	South Carolina	21.0%
9	Washington	20.8%
10	North Carolina	20.6%
	U.S. AVERAGE	11.2%

Source: U.S. Bureau of Labor Statistics

Employment Distribution

Nevada | December 2023

The leisure and hospitality sector, which includes tourism, is the largest sector, making up almost 23 percent of the workforce. It is followed closely by trade, transportation, and utilities, professional and business services and government employment.



Source: U.S. Bureau of Labor Statistics

Employment Projections

Nevada | Top Job Growth Sectors By 2028

Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028, Applied Analysis.

Employment Projections

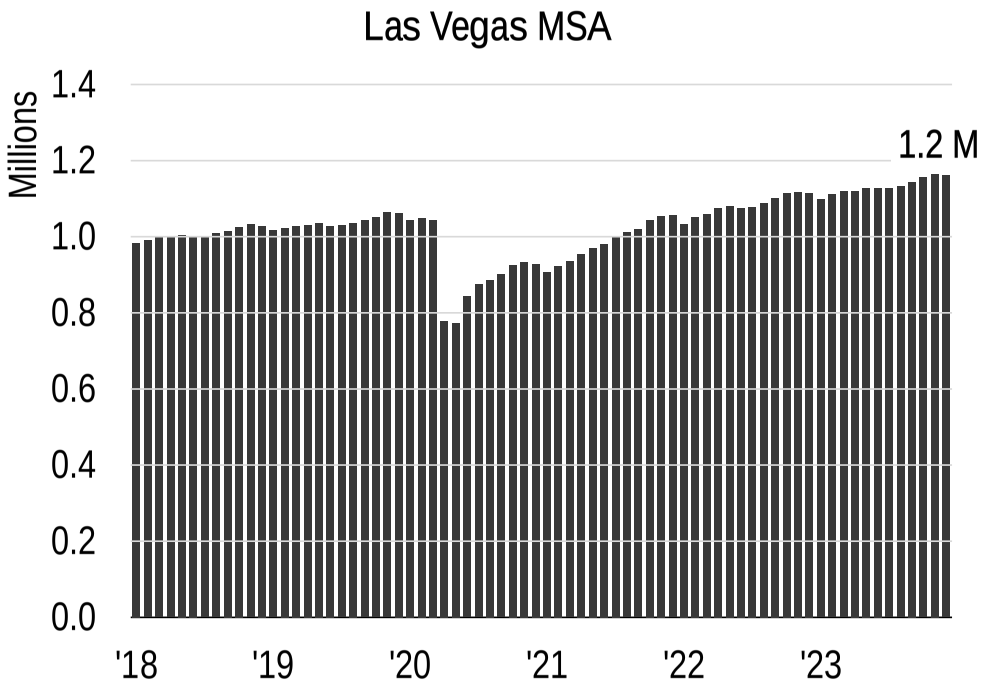
Nevada | Top Job Growth Sectors By 2028

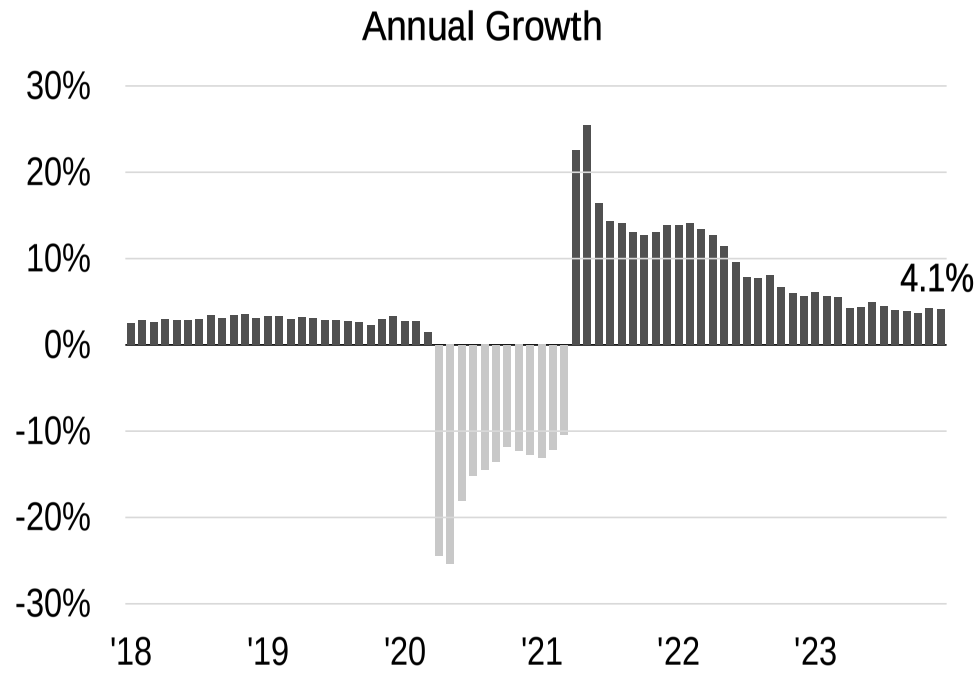
Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028, Applied Analysis.

Employment

Southern Nevada

The statewide trend of strong employment growth since the pandemic was mirrored in Southern Nevada, where job expansion has gradually slowed while remaining among the fastest in the nation.

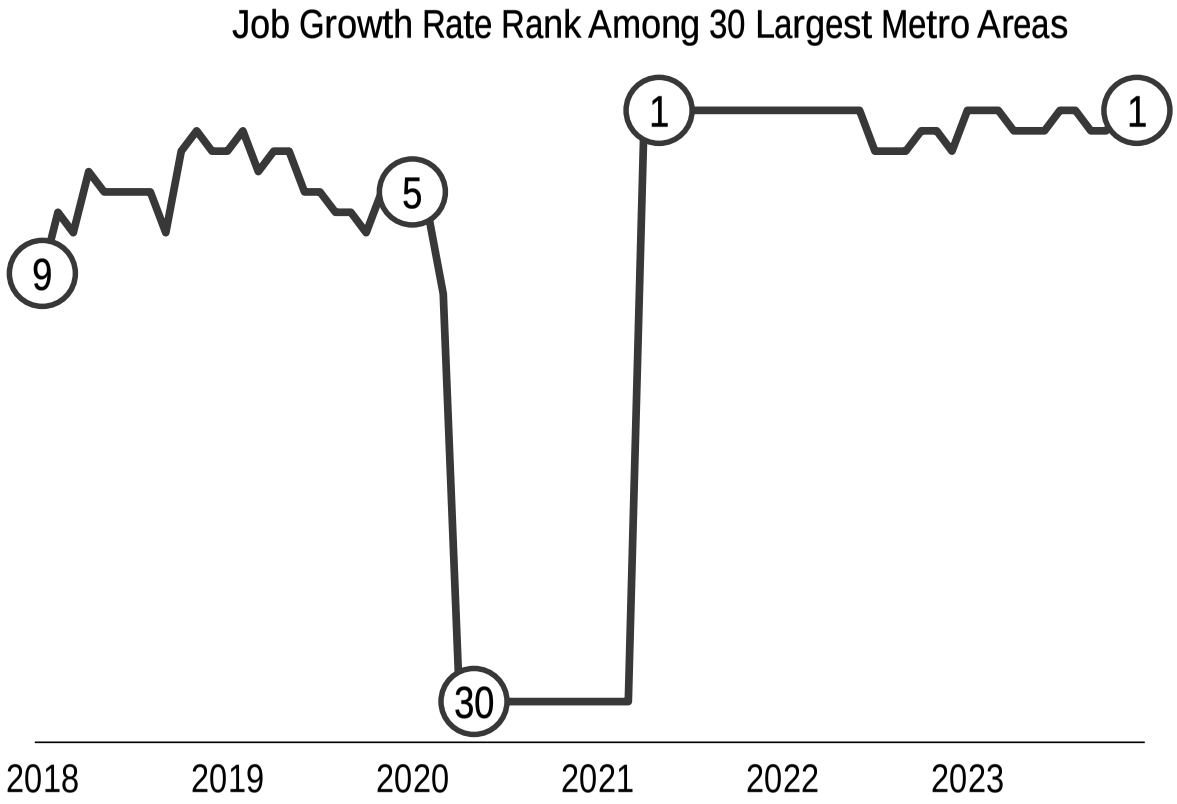




Source: U.S .Bureau of Labor Statistics

Employment Growth

Southern Nevada



Southern Nevada emerged from the pandemic with the fastest job growth among the 30 largest metropolitan statistical areas.

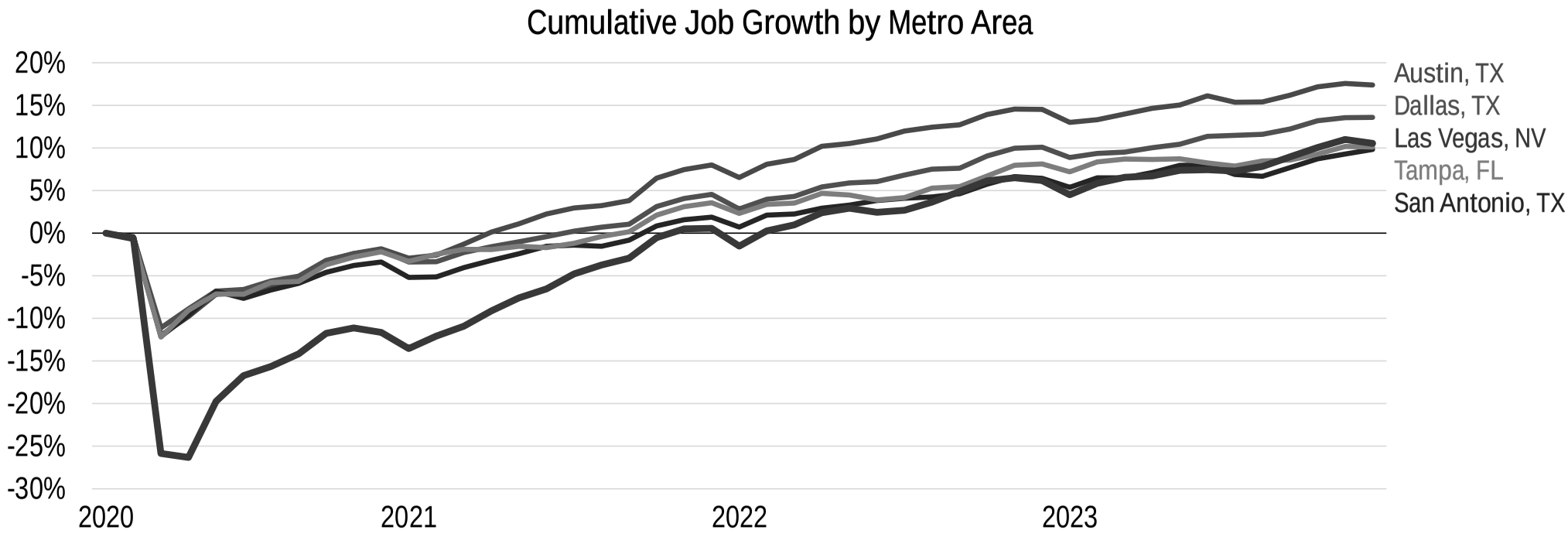
Since April 2021, the region's year-over-year job growth rate has ranked among the top three in every month, including 21 months ranked first.

Source: U.S. Bureau of Labor Statistics, Applied Analysis

Employment Growth

Southern Nevada

Similar to the statewide trend, Southern Nevada has regained the jobs lost during the pandemic and then some. The region's 10.5 percent cumulative job growth rate since February 2020 ranked third best among the 30 largest metro areas.

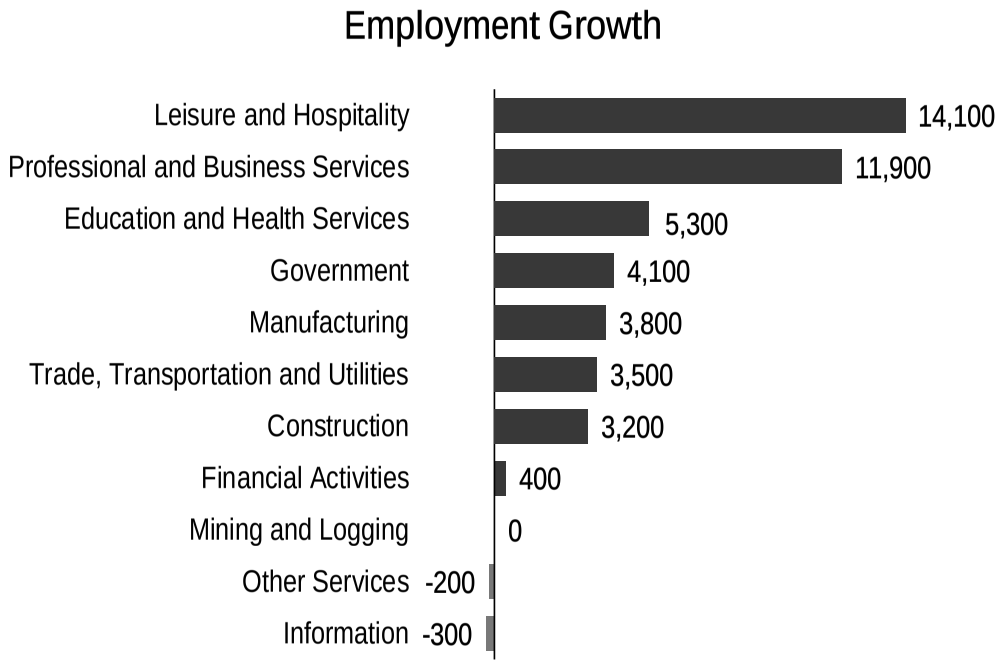


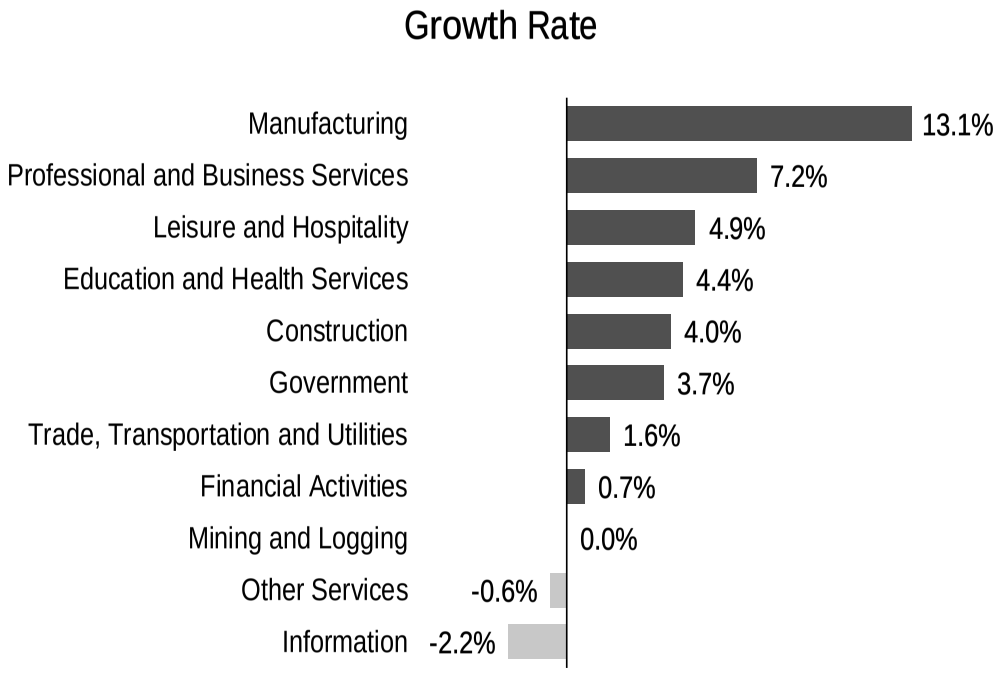
Source: U.S. Bureau of Labor Statistics, Applied Analysis. Note: Ranking based on 30 largest metropolitan statistical areas.

Employment Growth

Southern Nevada | December 2022 vs December 2023

Consistent across-the-board job growth through 2023 increased employment for most major industry sectors, with notable gains in manufacturing and professional and business services.



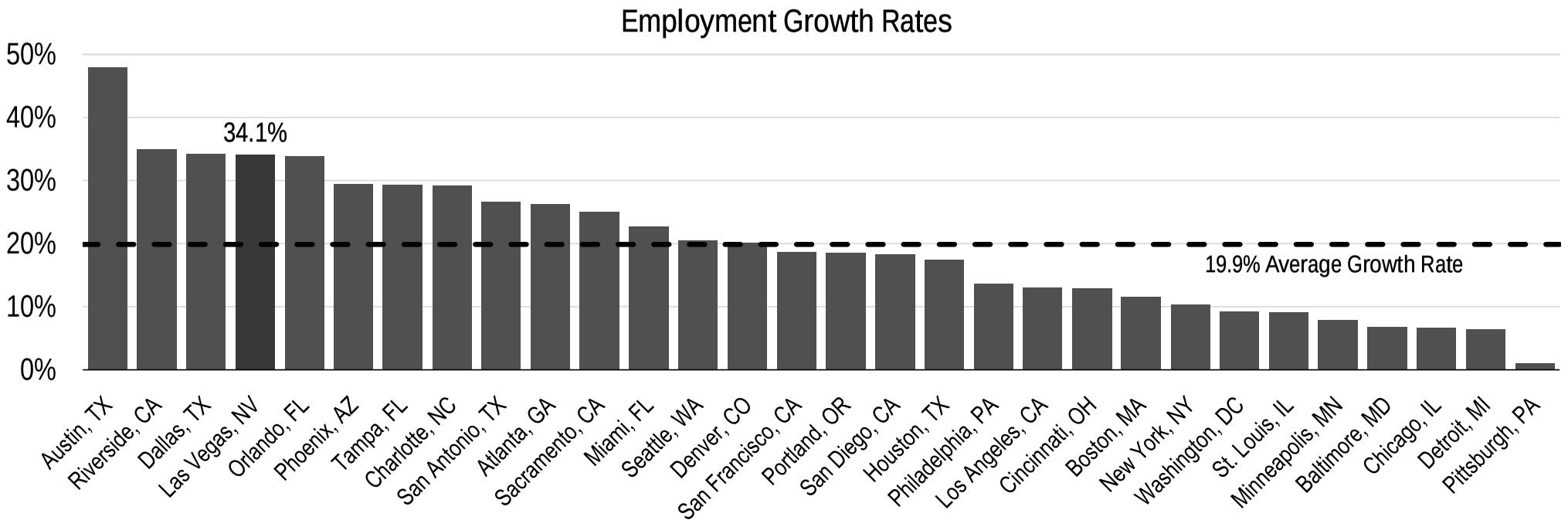


Source: U.S. Bureau of Labor Statistics

Employment Growth

30 Largest Metro Areas | December 2013 vs. December 2023

Southern Nevada's job growth over the past decade was the fourth-fastest among the 30 largest metropolitan areas.

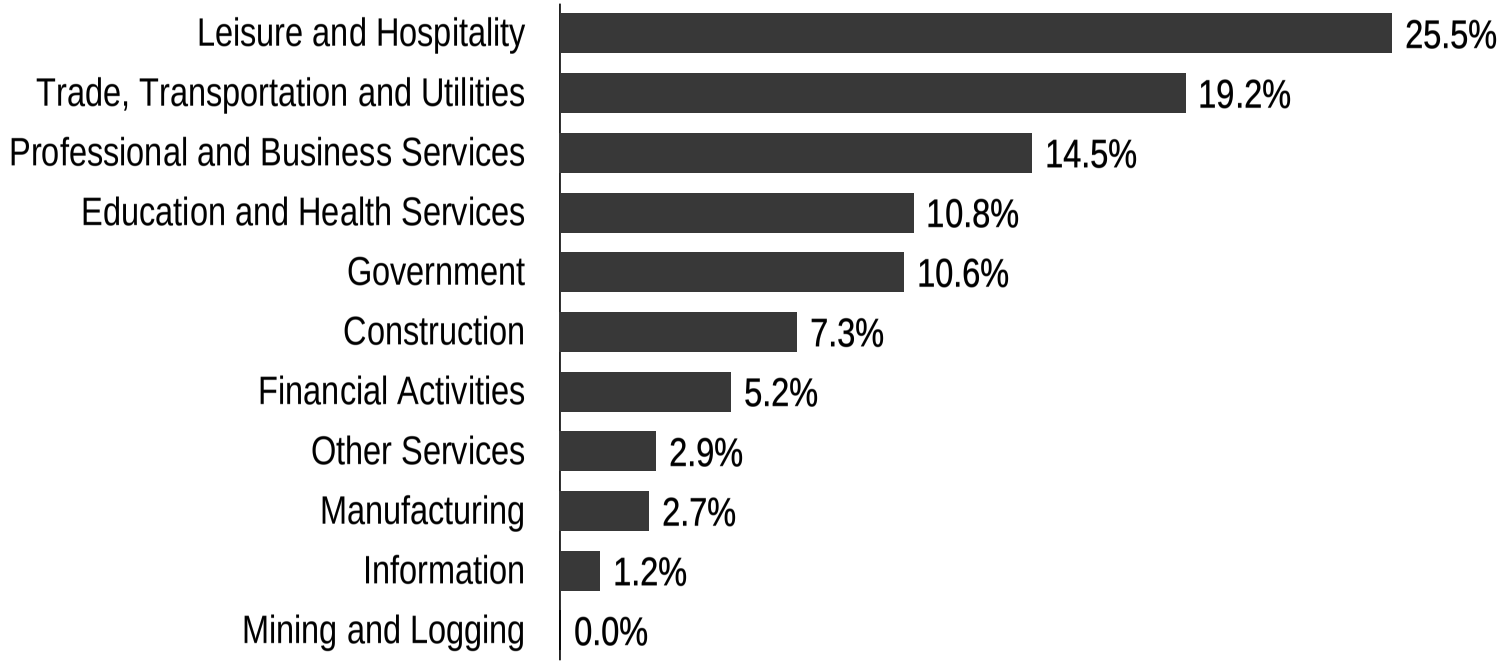


Source: U.S. Bureau of Labor Statistics.

Employment Distribution

Southern Nevada | December 2023

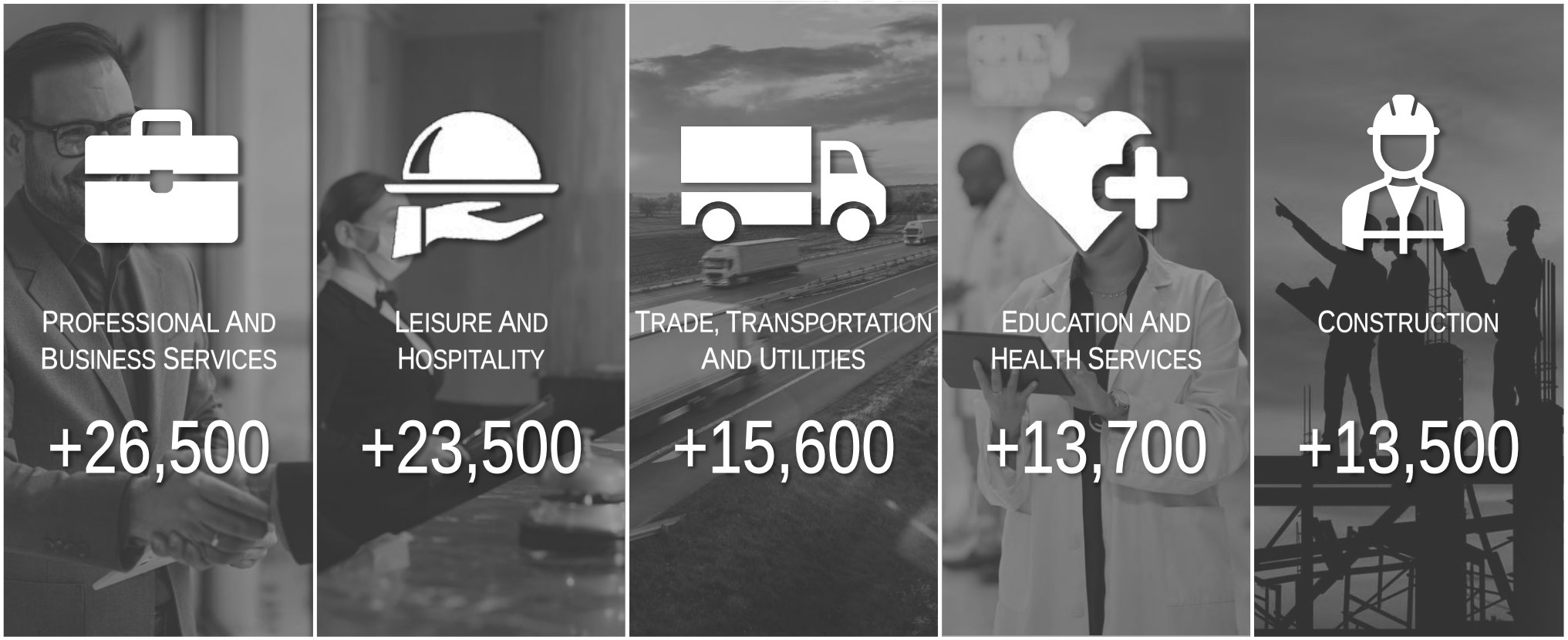
Leisure and hospitality is the largest employment sector in Southern Nevada, making up almost 26 percent of the workforce. It is followed by trade, transportation, and utilities, and professional and business services.



Source: U.S. Bureau of Labor Statistics

Employment Projections

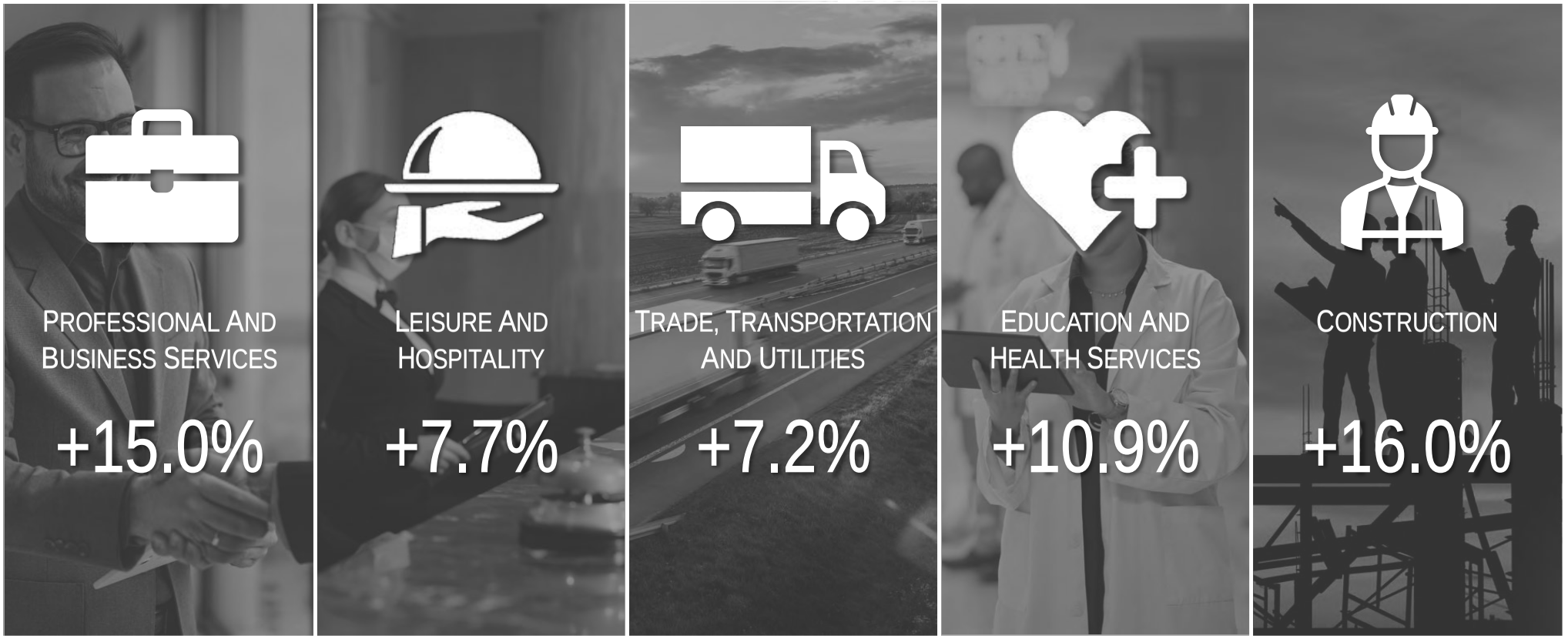
Southern Nevada | Top Job Growth Sectors By 2028



Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028

Employment Projections

Southern Nevada | Top Job Growth Sectors By 2028

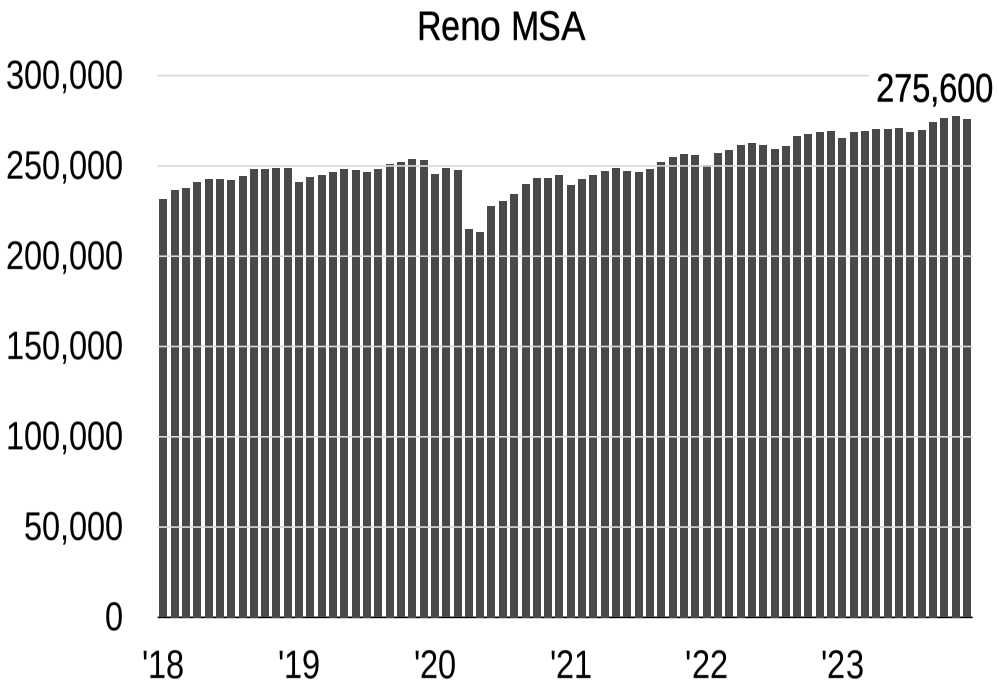


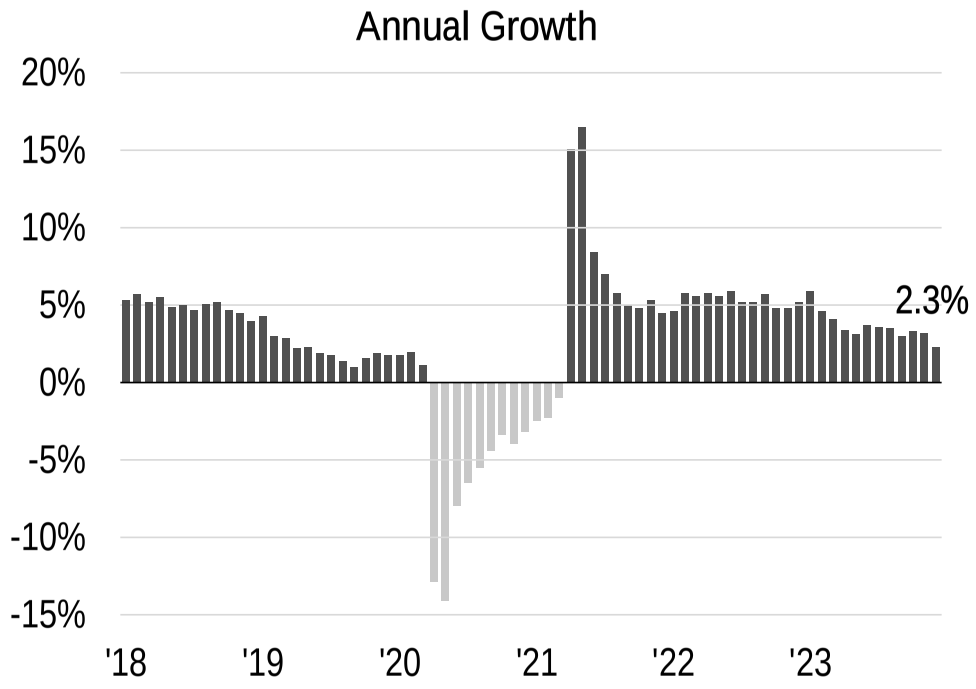
Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028

Employment Growth

Northern Nevada

Employment in Northern Nevada has consistently increased over the past few years. The pandemic-related decline in Northern Nevada was not as deep as that in tourism-heavy Southern Nevada, and the jobs recovery has been steadier.



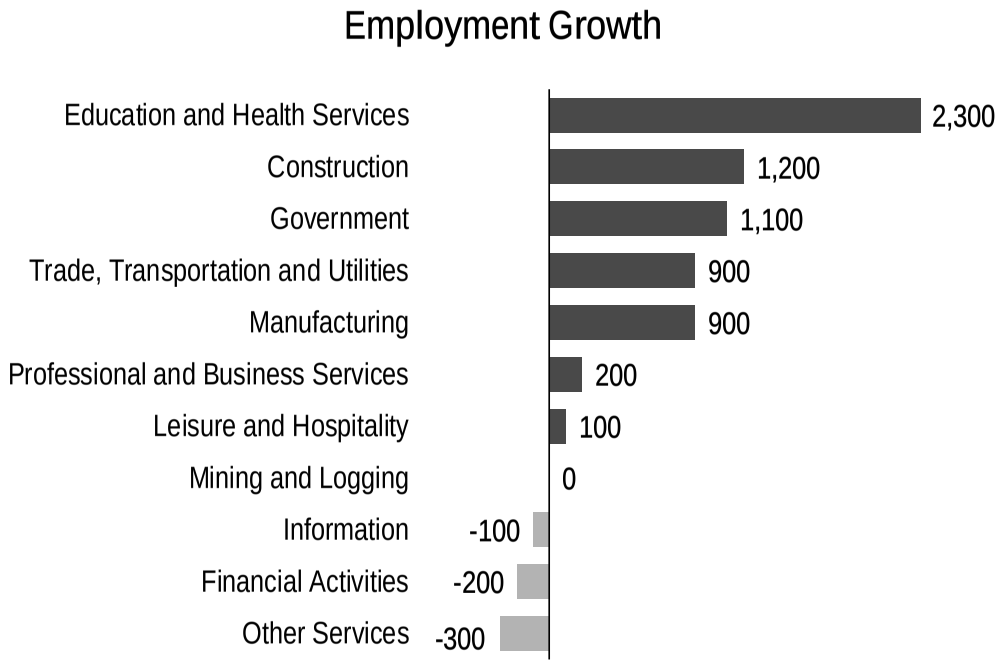


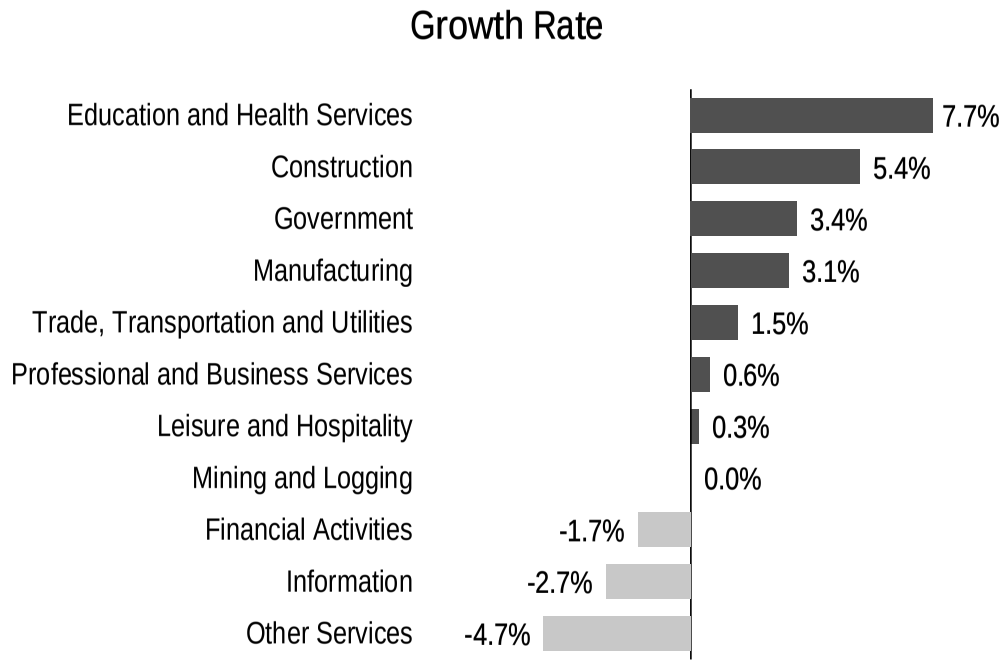
Source: U.S .Bureau of Labor Statistics

Employment Growth

Northern Nevada | December 2022 vs. December 2023

Education and health services led employment growth over the past year, followed by construction and government.



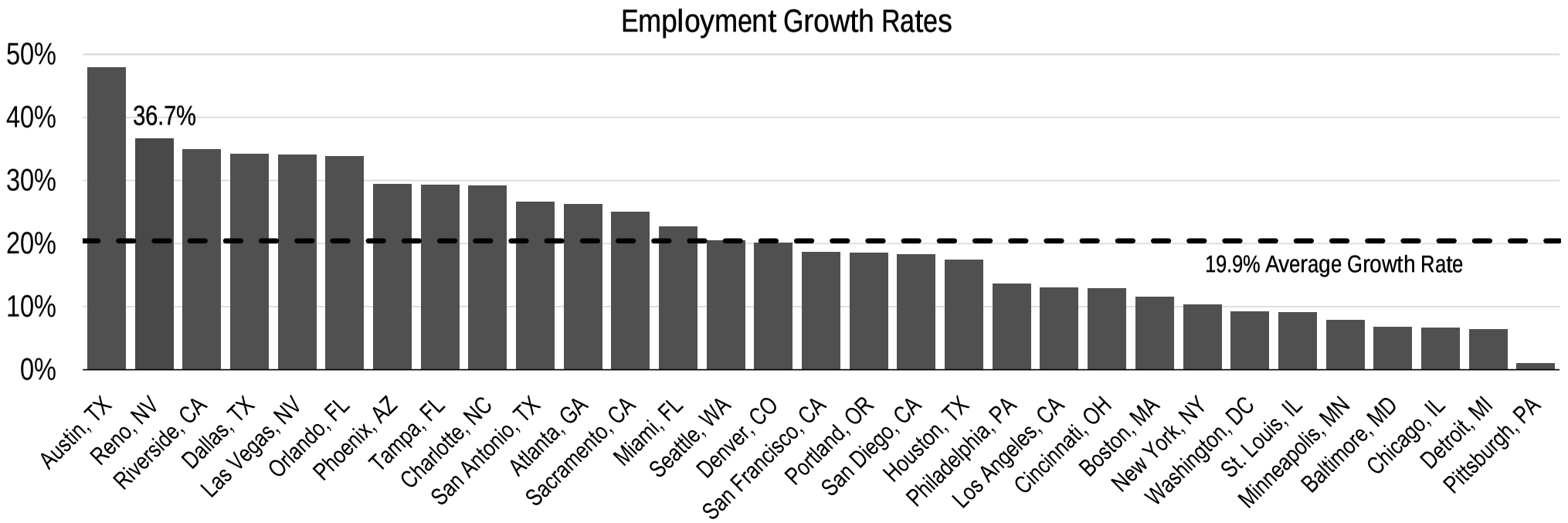


Source: U.S. Bureau of Labor Statistics

Employment Growth

Northern Nevada | December 2013 vs. December 2023

When compared with the 30 largest metropolitan areas, Northern Nevada had the second-fastest employment growth over the past decade.

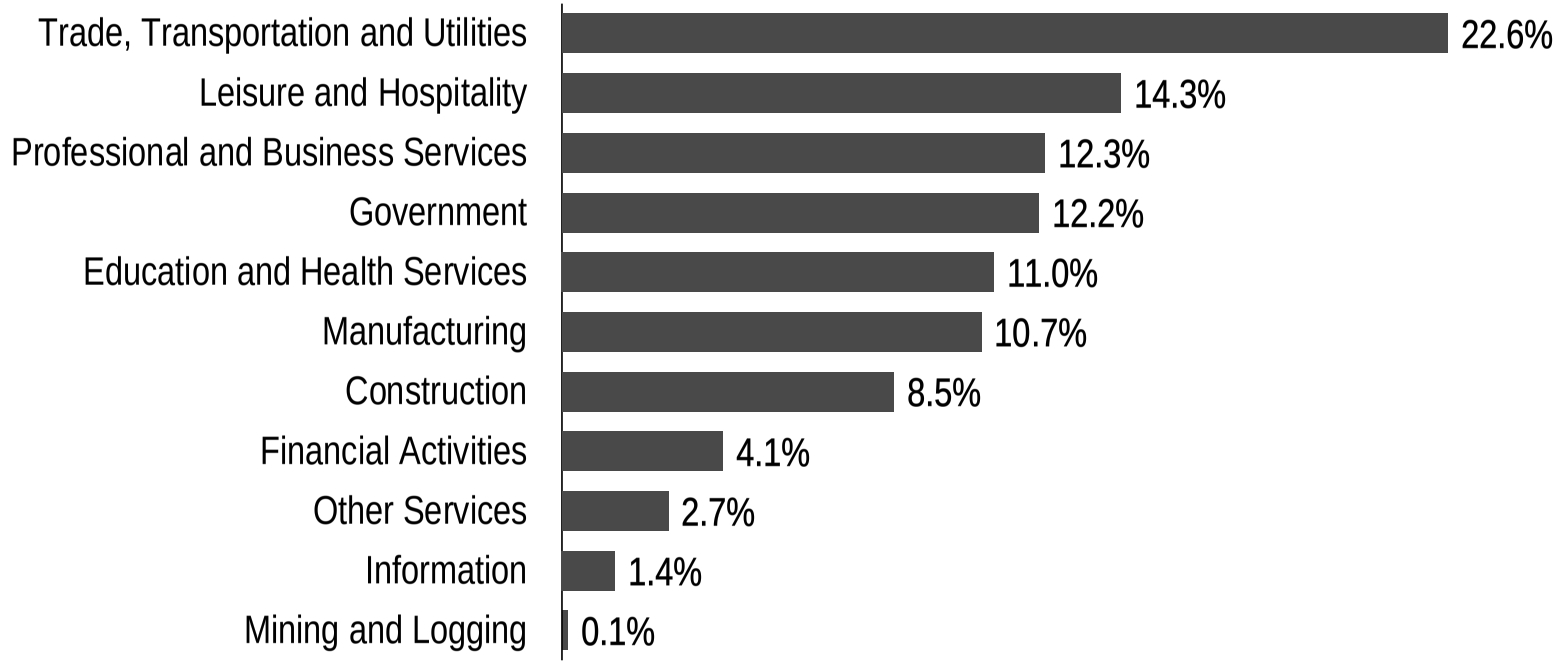


Source: U.S. Bureau of Labor Statistics

Employment Distribution

Northern Nevada | December 2023

In contrast to Southern Nevada, Northern Nevada's largest employment sector is trade, transportation and utilities sector, with 22 percent of the workforce. It is followed by the leisure and hospitality and professional and business services sectors.



Source: U.S. Bureau of Labor Statistics

Employment Projections

Northern Nevada | Top Job Growth Sectors By 2028

Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028

Employment Projections

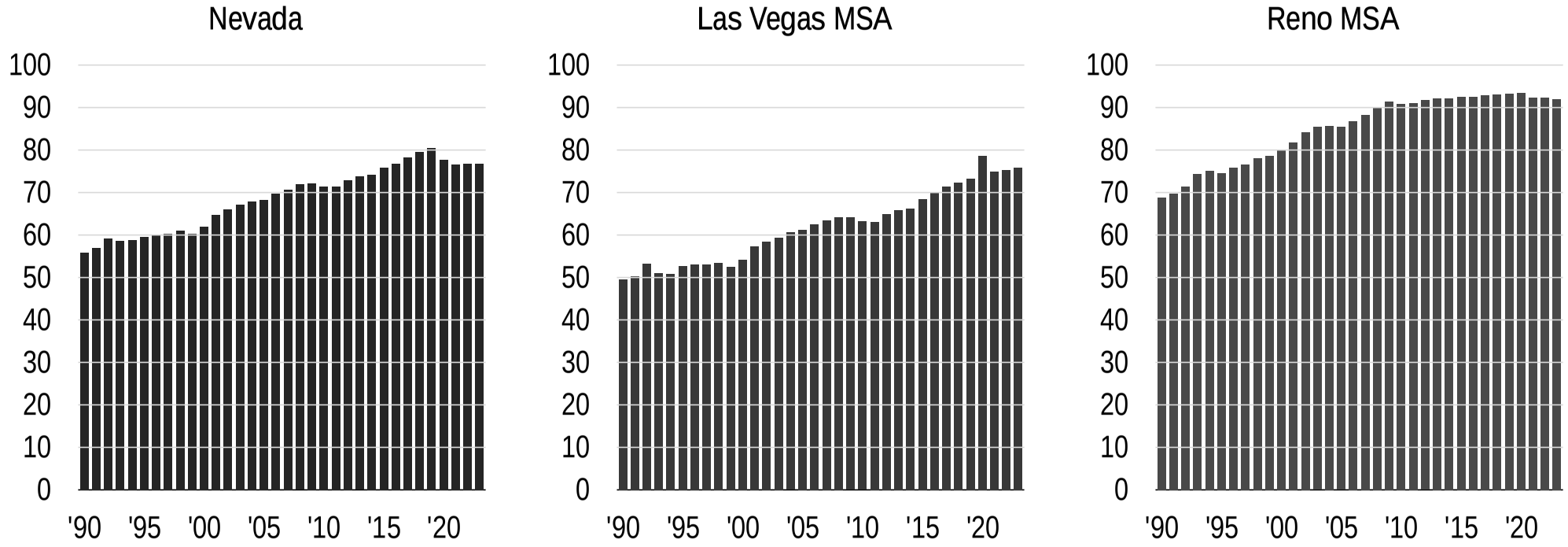
Northern Nevada | Top Job Growth Sectors By 2028

Source: Nevada Department of Employment, Training, and Rehabilitation, Long Term Industry Projections 2018-2028

Industry Diversity

Nevada

Industrial diversity in Nevada's employment profile has steadily increased over several decades as other sectors have grown beyond leisure and hospitality. Northern Nevada has historically had a more diverse economy compared to Southern Nevada.

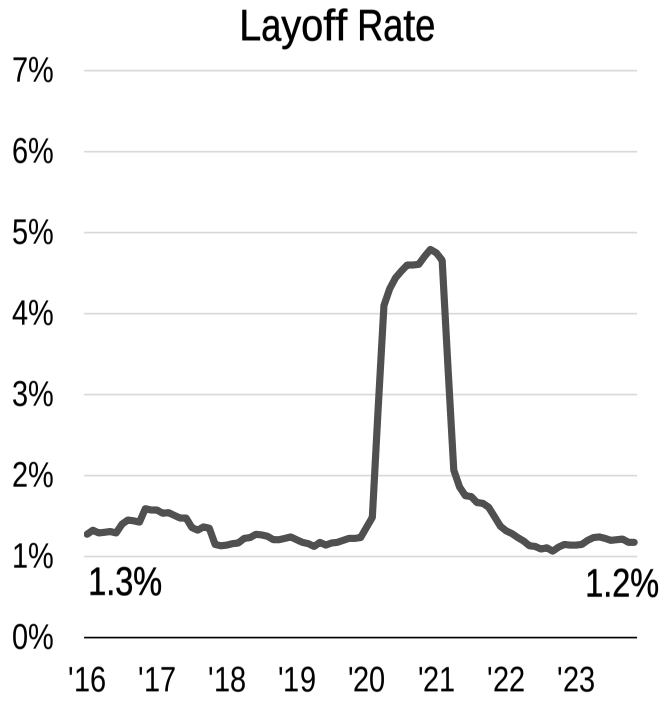


Source: Applied Analysis. Note: The Hachman Index is a measure of economic diversity. It compares an area's industry employment mix against the industry employment mix of the United States.

Labor Market

Nevada

Key measures of the labor market in Nevada have returned to pre-pandemic levels as the labor market has stabilized following a period of pandemic-related disruptions.

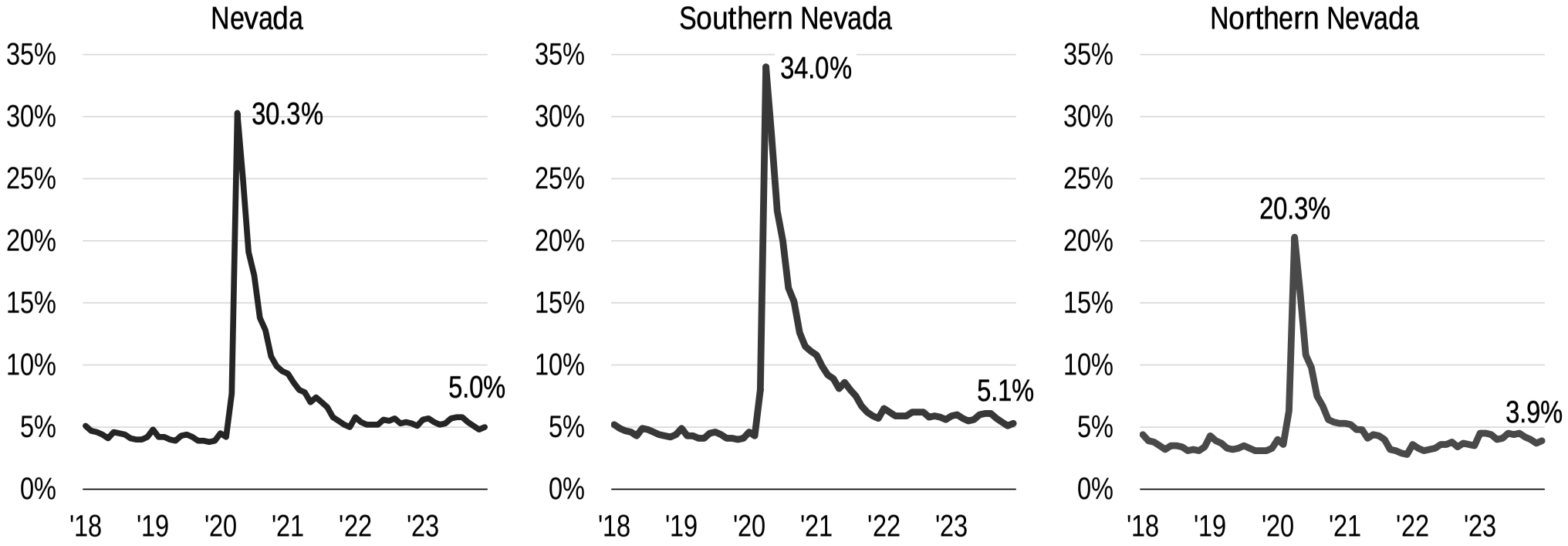


Source: U.S. Bureau of Labor Statistics; Applied Analysis. Note: Trailing 12-Month Averages.

Unemployment Rate

Nevada

Unemployment rates across Nevada have improved considerably since their pandemic-related highs. They remain slightly elevated compared to pre-pandemic levels, though that is largely a function of an expanding labor force rather than layoffs.

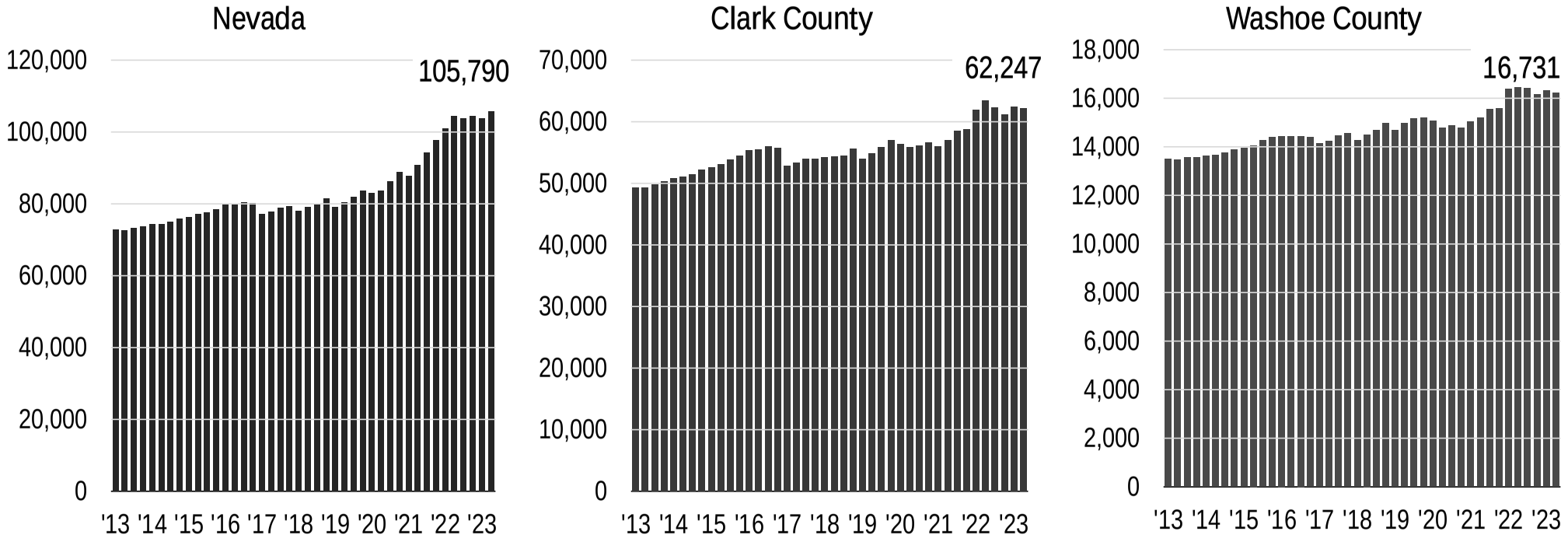


Source: U.S. Bureau of Labor Statistics

Private Establishments

Nevada

Business growth across the state accelerated in the wake of the pandemic, a trend mirrored at the national level.



Source: U.S. Bureau of Labor Statistics

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

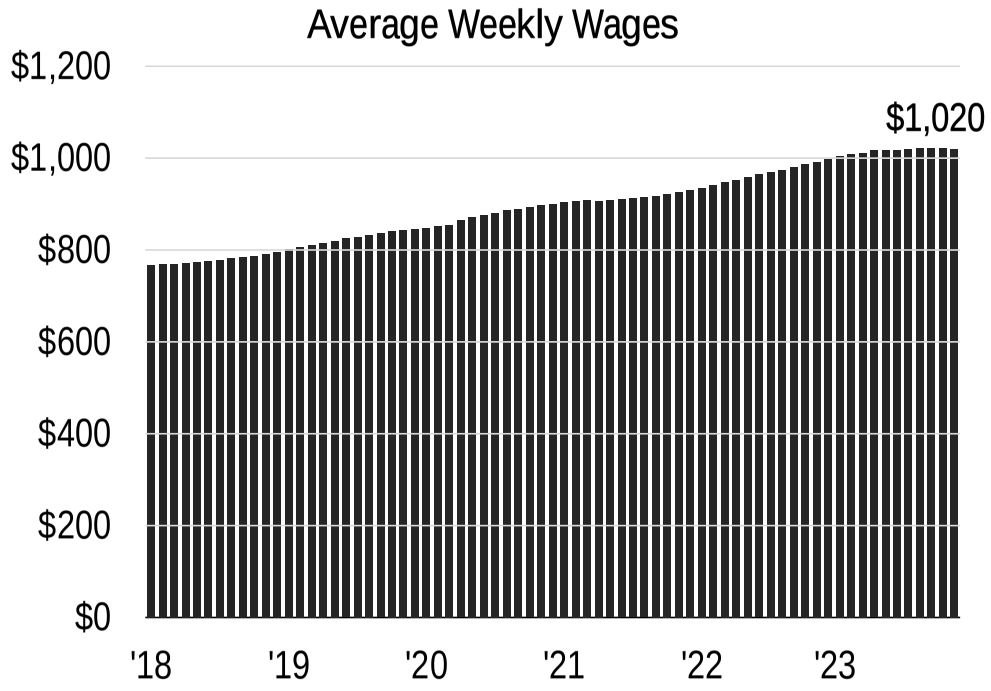
POPULATION AND MIGRATION

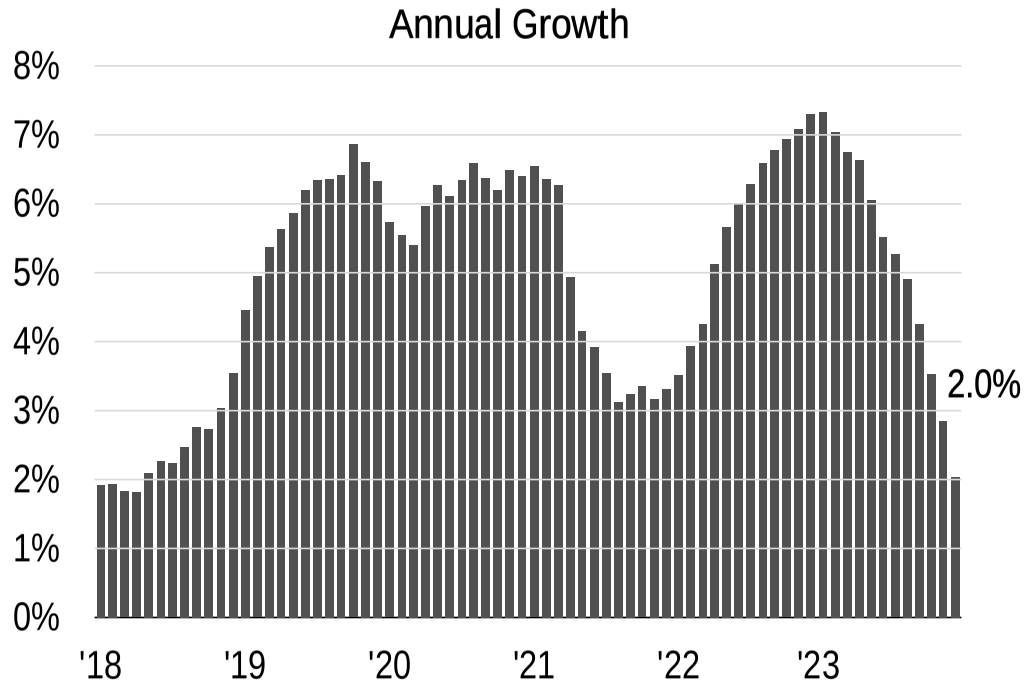
DEVELOPMENT PIPELINE

Employee Earnings

Nevada

At different points after the pandemic, wage growth accelerated as demand for workers climbed amid the fast-emerging economy and inflation climbed to four-decade highs. Over the past year, wage growth has slowed as conditions normalized.



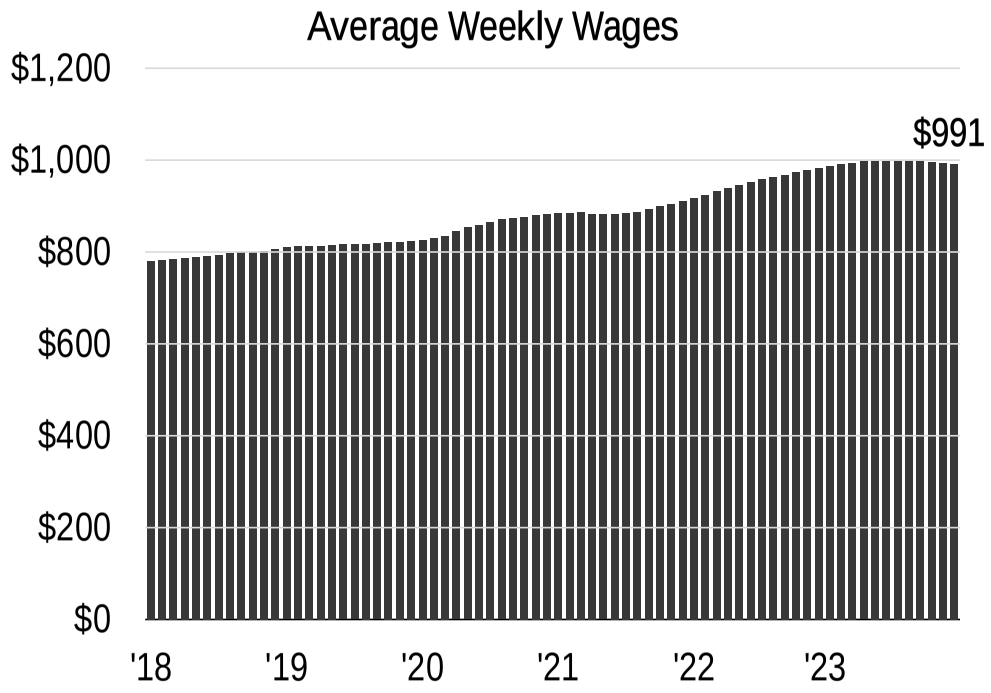


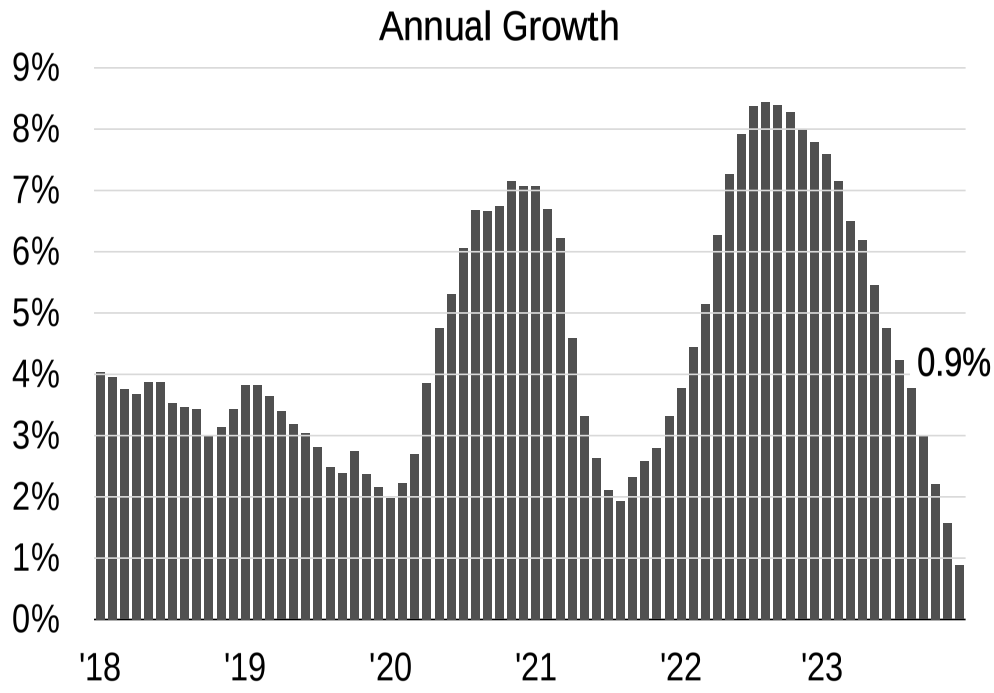
Source: U.S. Bureau of Labor Statistics. Note: Trailing 12-Month Averages.

Employee Earnings

Southern Nevada

Wage growth volatility was more pronounced in Southern Nevada over the past several years. Over the past year, the growth rate has slowed dramatically, closing the year at 0.9 percent.



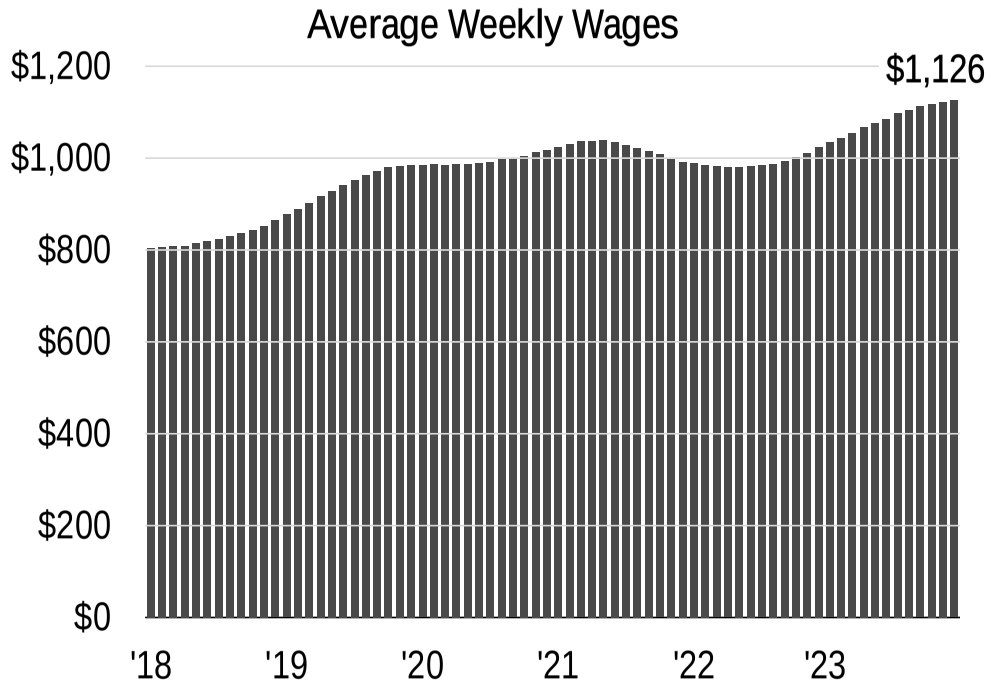


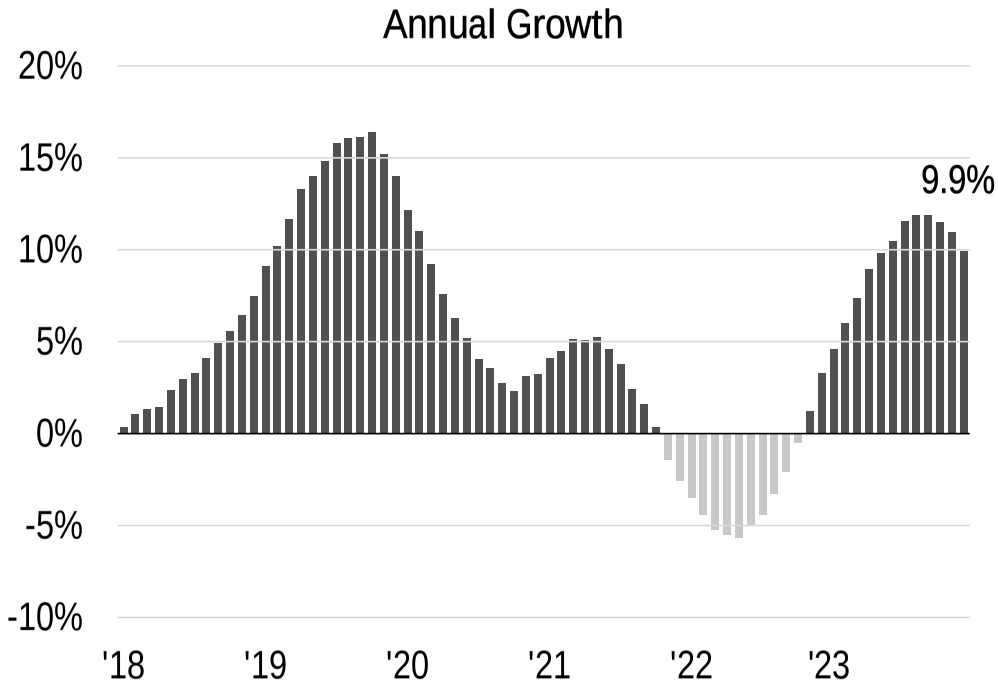
Source: U.S. Bureau of Labor Statistics; Note: Data presented shows trailing 12-month averages.

Employee Earnings

Northern Nevada

Wage growth in Northern Nevada was consistently positive through 2023, climbing past 10 percent at its peak and ending the year just below that mark.



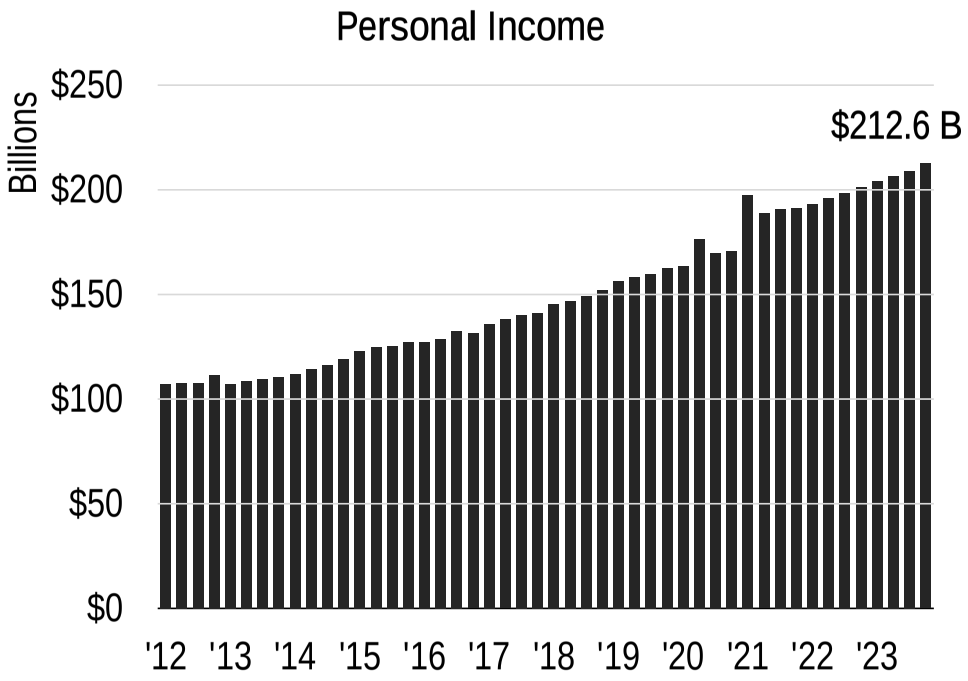


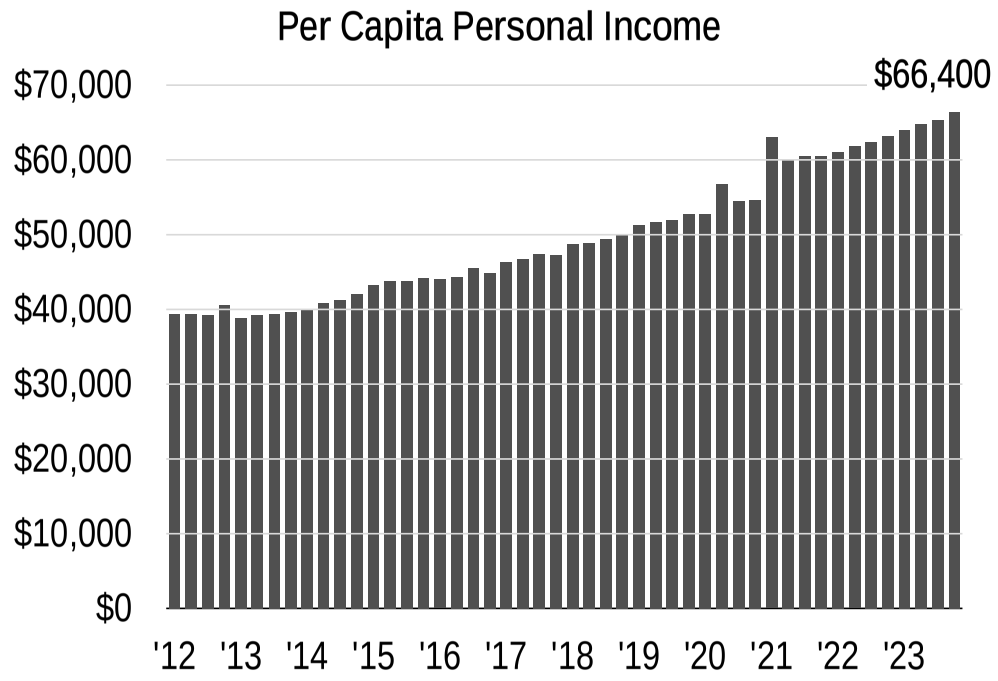
Source: U.S. Bureau of Labor Statistics; Note: Data presented shows trailing 12-month averages.

Personal Income

Nevada

Nevada's personal income set a record of $212.6 billion in 2023, marking a 10-year growth rate of 92.4 percent over that period. On a per-capita basis, personal income climbed to a record $66,400.



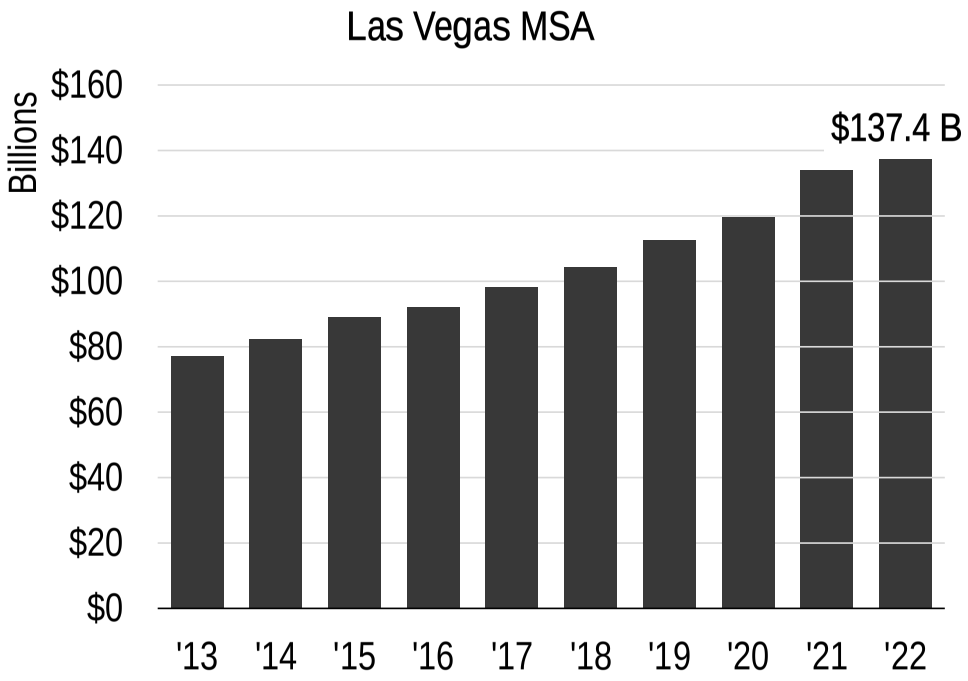


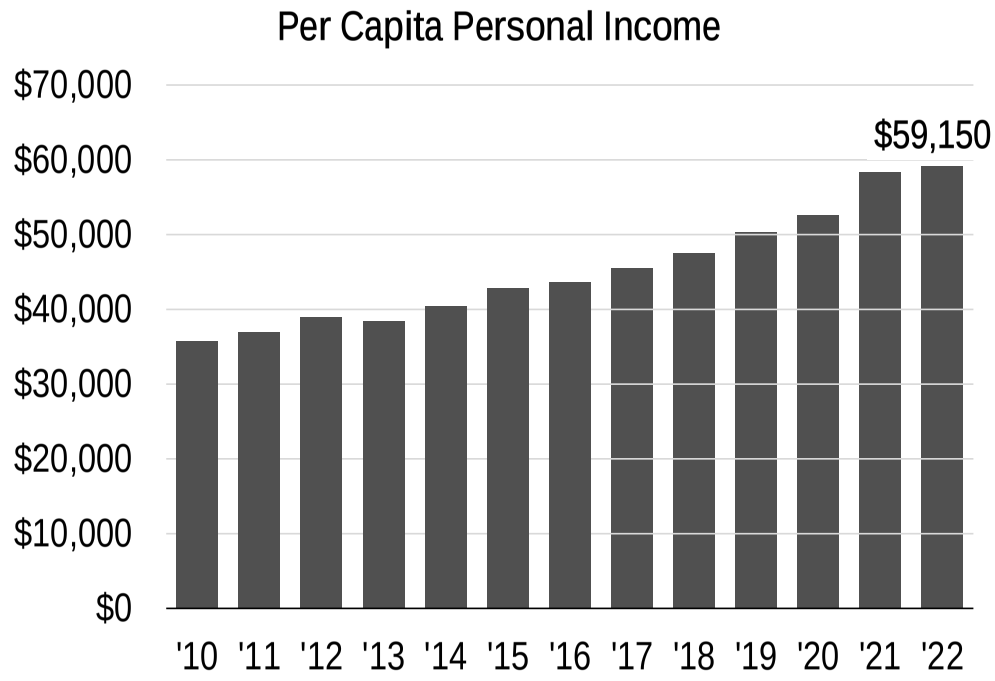
Source: Bureau of Economic Analysis; Note: Data presented is seasonally adjusted. 2023 data through the third quarter.

Personal Income

Southern Nevada

Since 2013, aggregate personal income in Southern Nevada grew by 78.2 percent. Per capita personal income increased by 52.0 percent over the 10-year period.



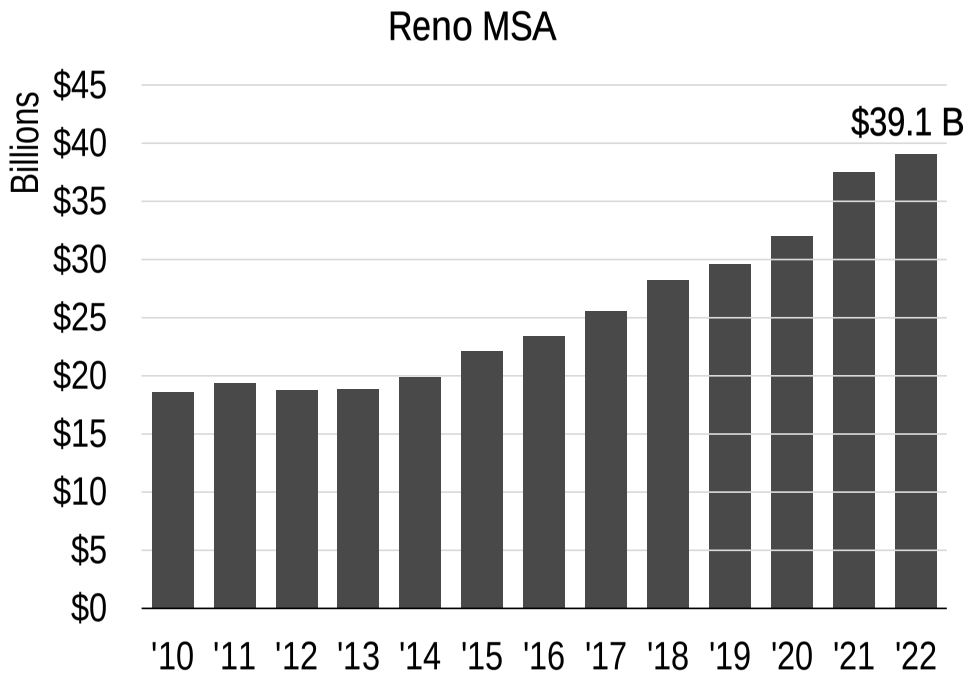


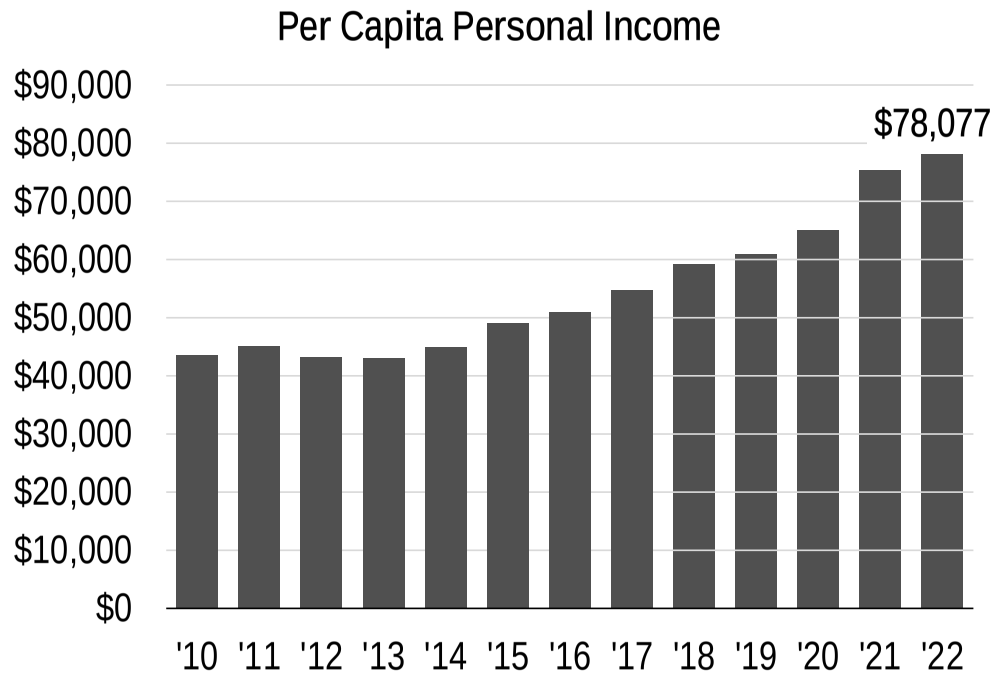
Source: Bureau of Economic Analysis; Note: Data presented is seasonally adjusted.

Personal Income

Northern Nevada

In Northern Nevada, total personal income more than doubled over the past decade, rising 108.4 percent. Per capita personal income climbed by nearly $35,000, an 80.3 percent increase.



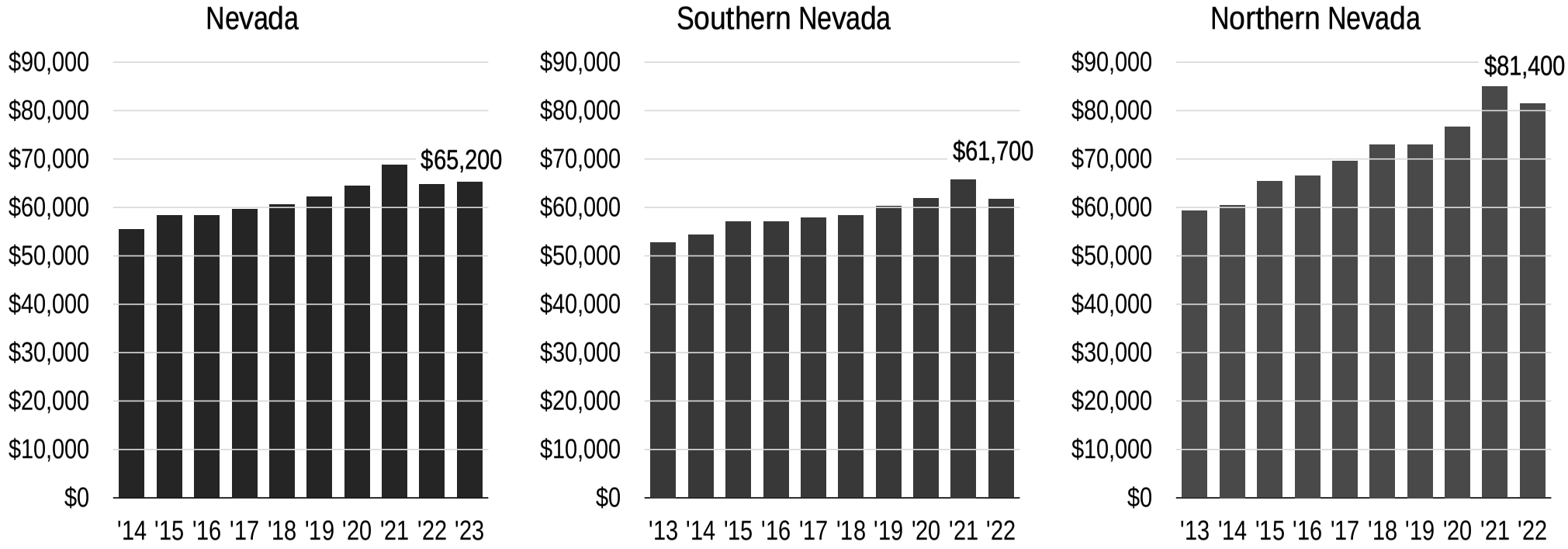


Source: Bureau of Economic Analysis; Note: Data presented is seasonally adjusted.

Per Capita Personal Income

Inflation-Adjusted

When accounting for the recent period of high inflation, per capita personal income has remained relatively flat compared to 2019. Northern Nevada is an exception, with inflation-adjusted per capita personal income growing 11.5 percent since 2019.

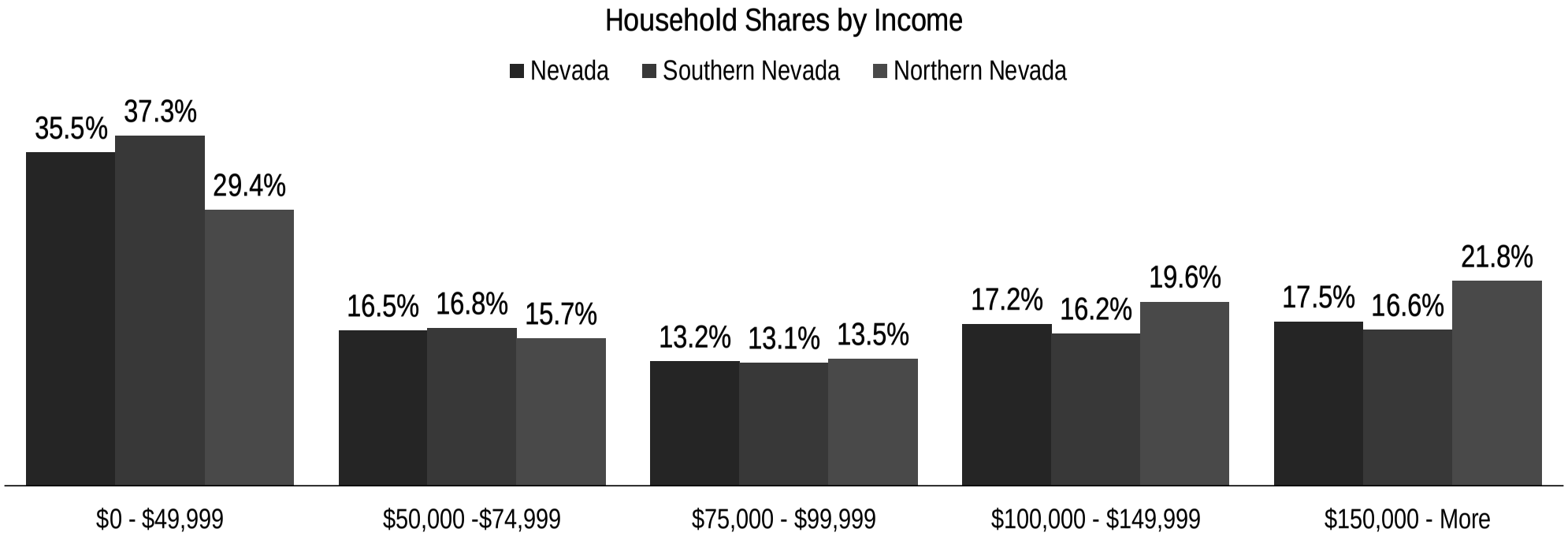


Source: U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, Applied Analysis. Note: Values shown in 2023 dollars.

Household Income

Nevada

Southern Nevada has a higher percentage of households in the lowest income range, while Northern Nevada has a greater share of households in the highest income categories.

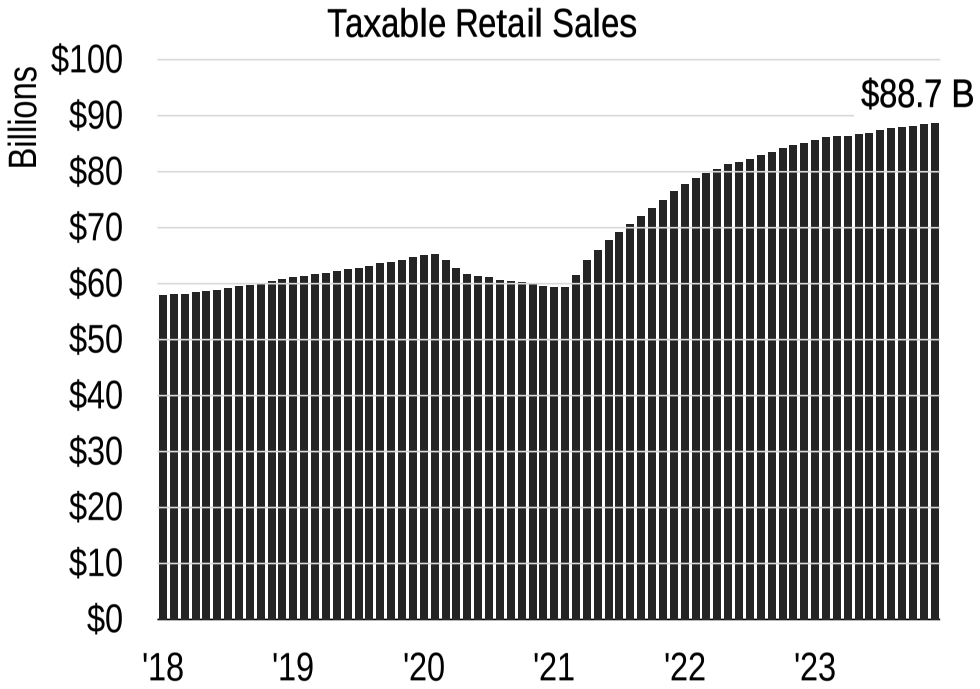


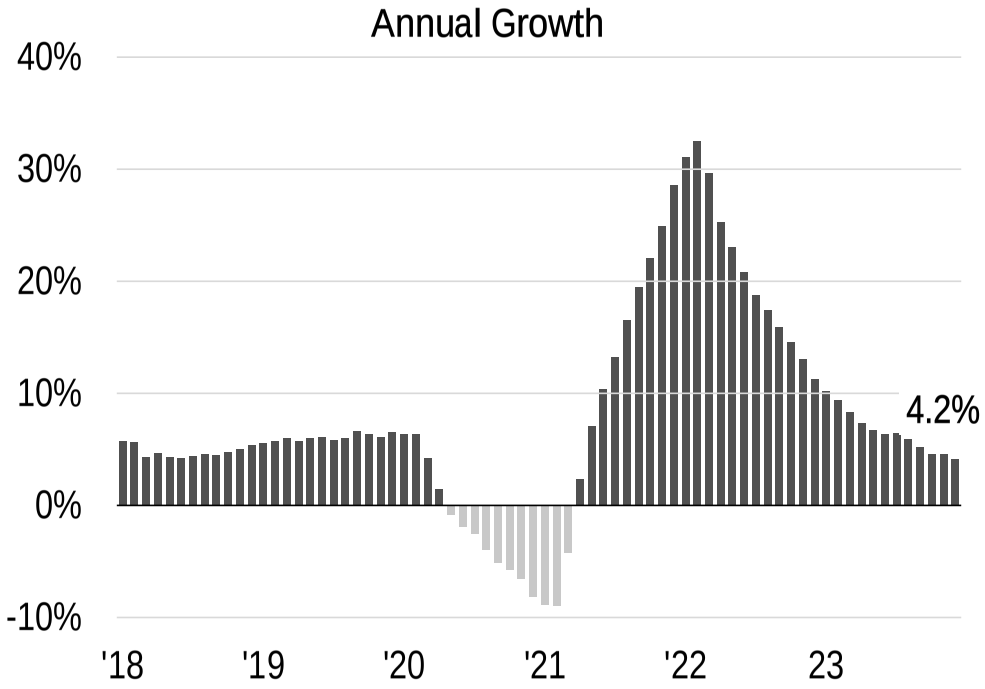
Source: Claritas. Note: Data shows 2024 estimated households by household income.

Taxable Sales

Nevada

Consumer spending in Nevada remained steady through 2023. The annual growth rate gradually slowed from the post-pandemic spending boom that included four-decade-high inflation.



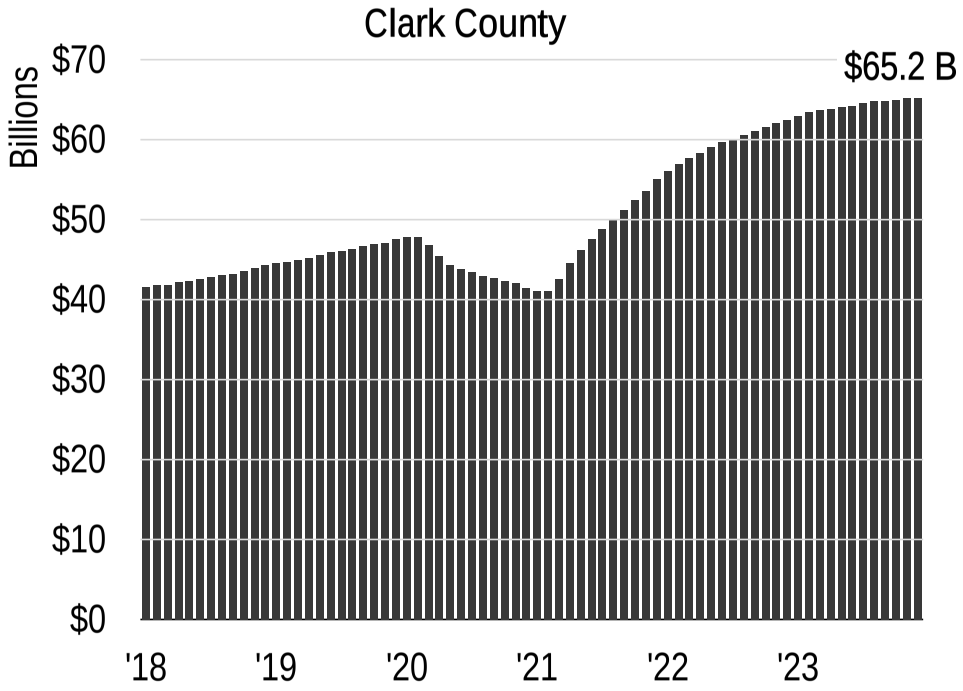


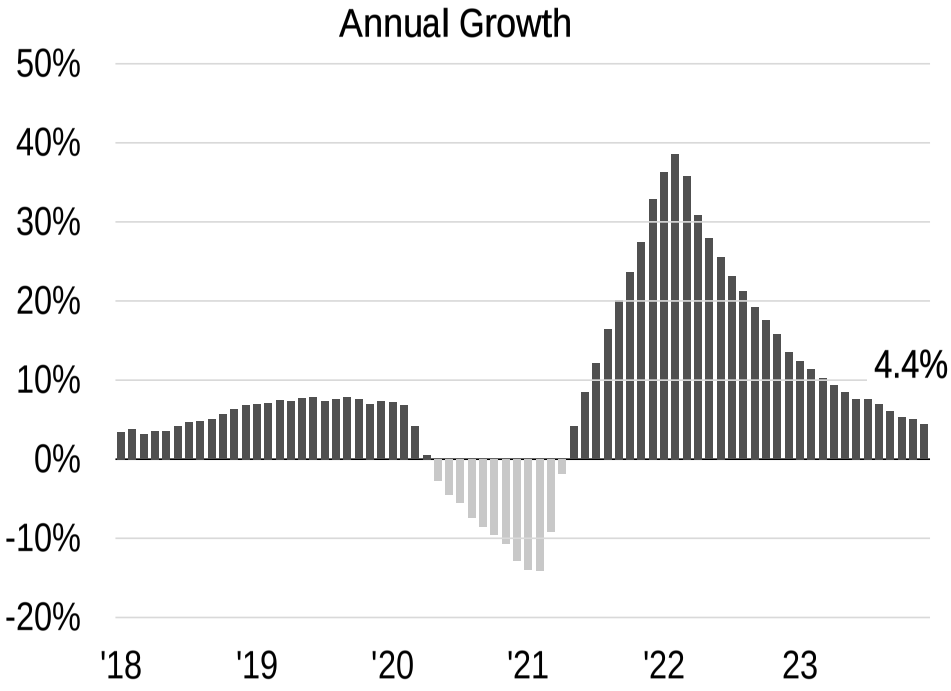
Source: Nevada Department of Taxation. Note: Data presented as trailing 12-month totals.

Taxable Sales

Southern Nevada

Taxable sales in Southern Nevada set a record high of $65.2 billion in 2023, even as the growth rate steadily normalized.



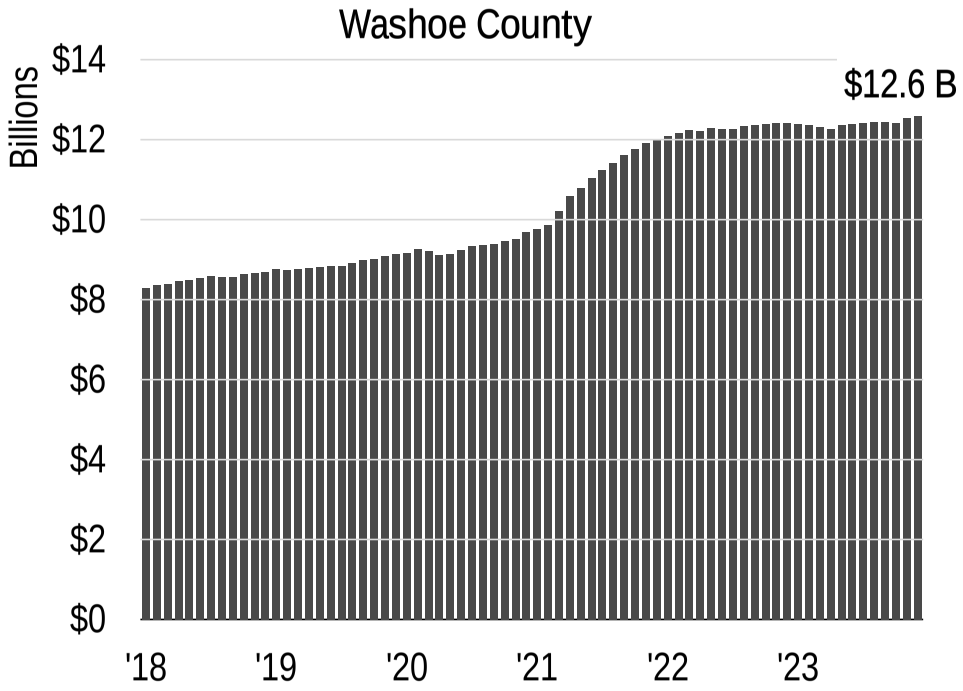


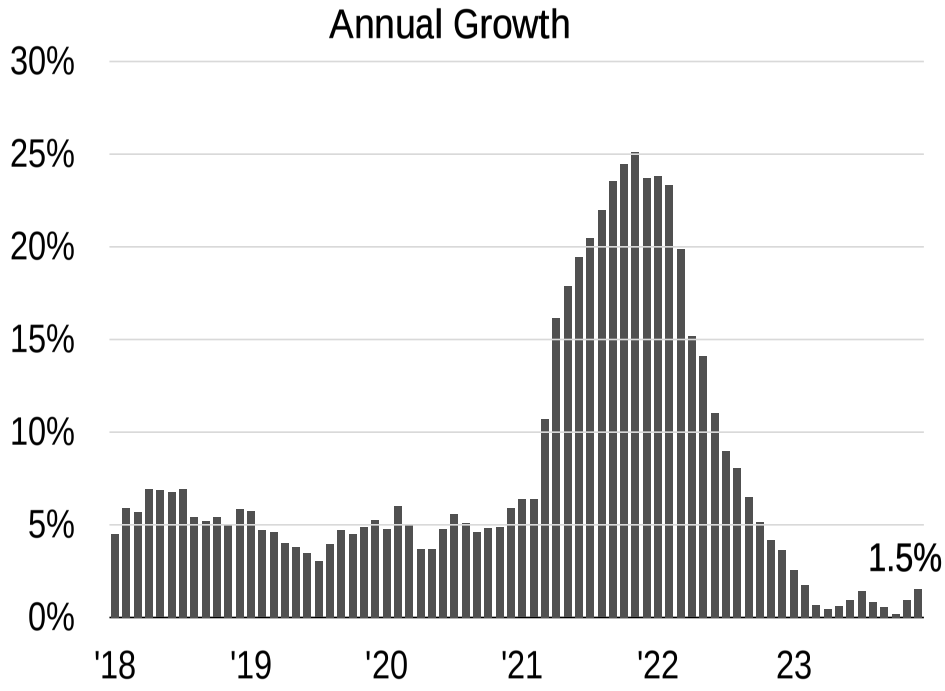
Source: Nevada Department of Taxation. Note: Data presented as trailing 12-month totals.

Taxable Sales

Northern Nevada

Taxable retail sales in Northern Nevada suffered minimal pandemic-related impact compared to Southern Nevada, however, their post-pandemic growth has been more tempered.



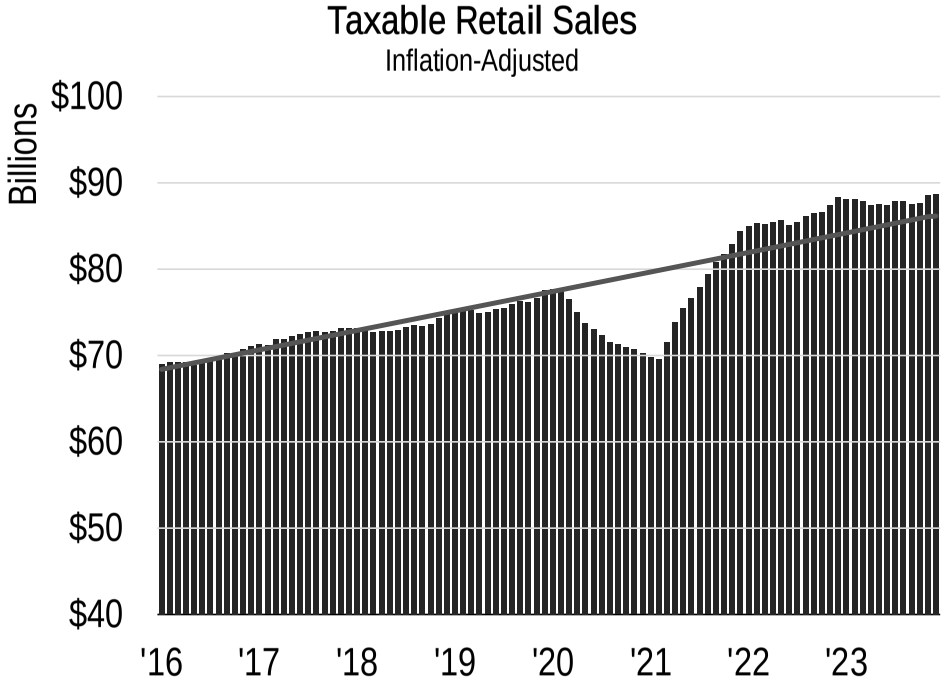


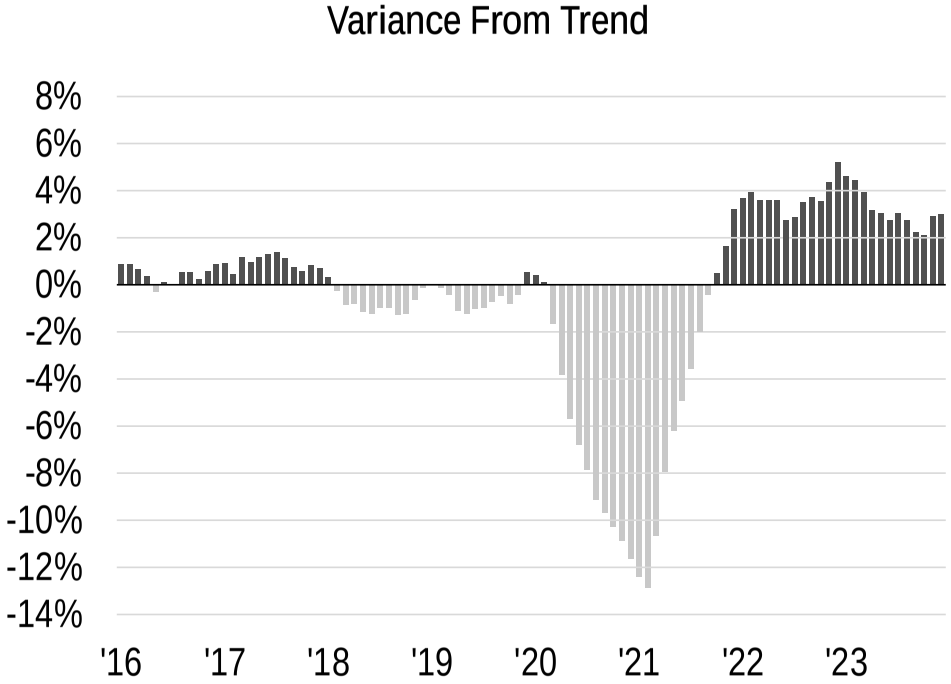
Source: Nevada Department of Taxation. Note: Data presented as trailing 12-month totals.

Inflation-Adjusted Taxable Sales

Nevada

Retail sales spiked during the pandemic recovery as household wealth climbed due to a number of factors. That wealth, especially accumulated excess savings, has been declining, and retail sales have been moving toward pre-pandemic trend.





Source: Nevada Department of Taxation; Federal Reserve Bank of St. Louis; Applied Analysis

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

POPULATION AND MIGRATION

DEVELOPMENT PIPELINE

Impact of Southern Nevada's Tourism Industry in 2022

$44.9 Billion
Direct Visitor Spending

358,880
Total Employment Impact

$20.1 Billion
Total Wages and Salaries Impact

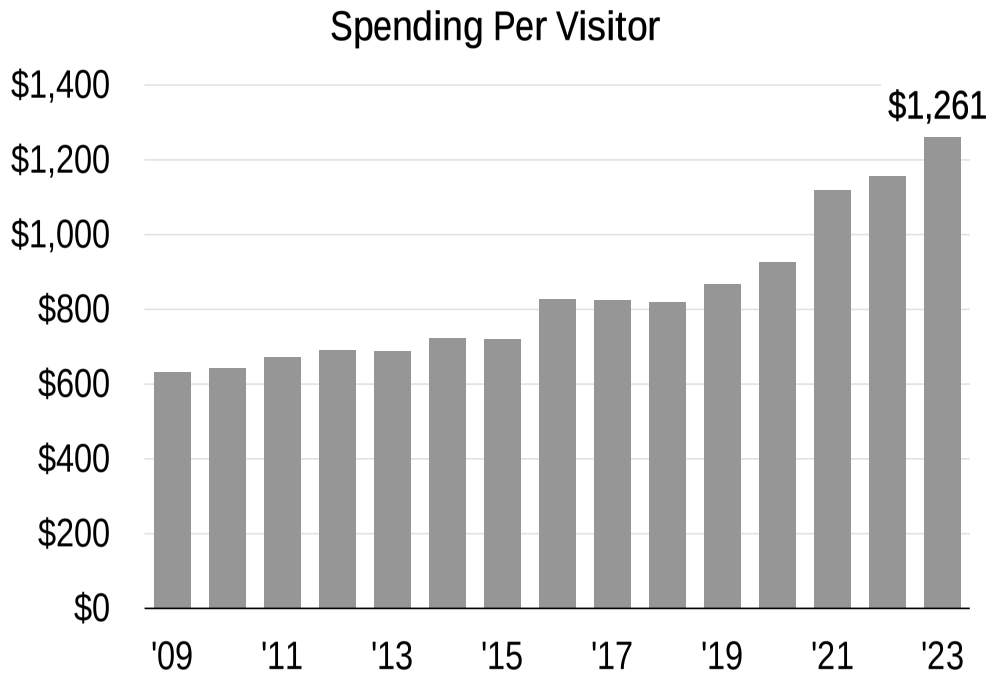
$79.3 Billion
Total Economic Output Impact

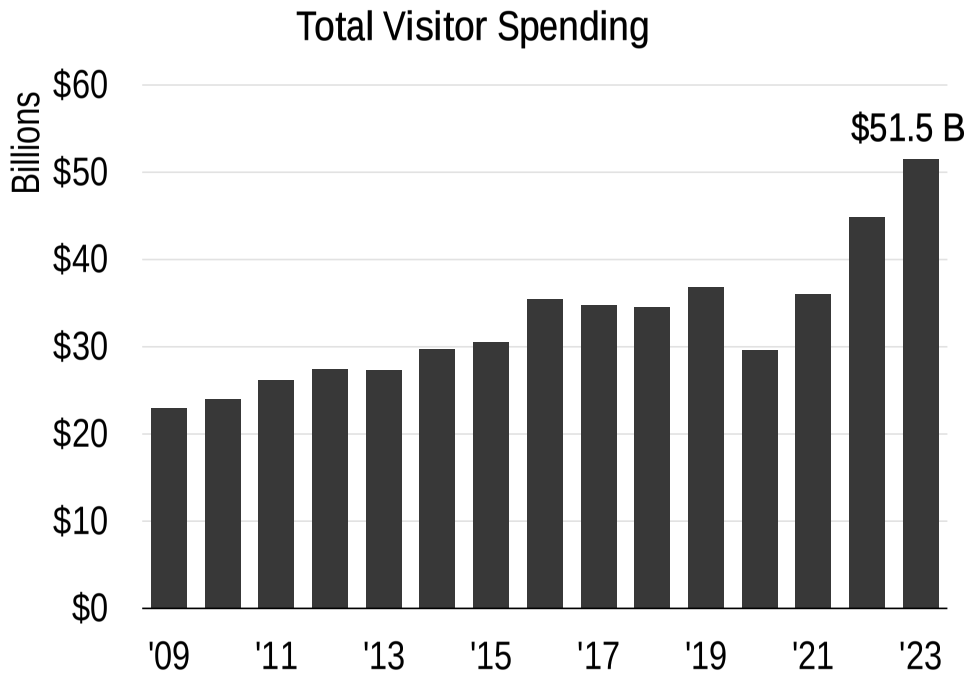
Source: Las Vegas Convention and Visitors Authority, Applied Analysis

Tourism Industry

Southern Nevada | Visitor Spending

Visitor spending reached all-time highs in 2023 on both a per-visitor and aggregate basis.



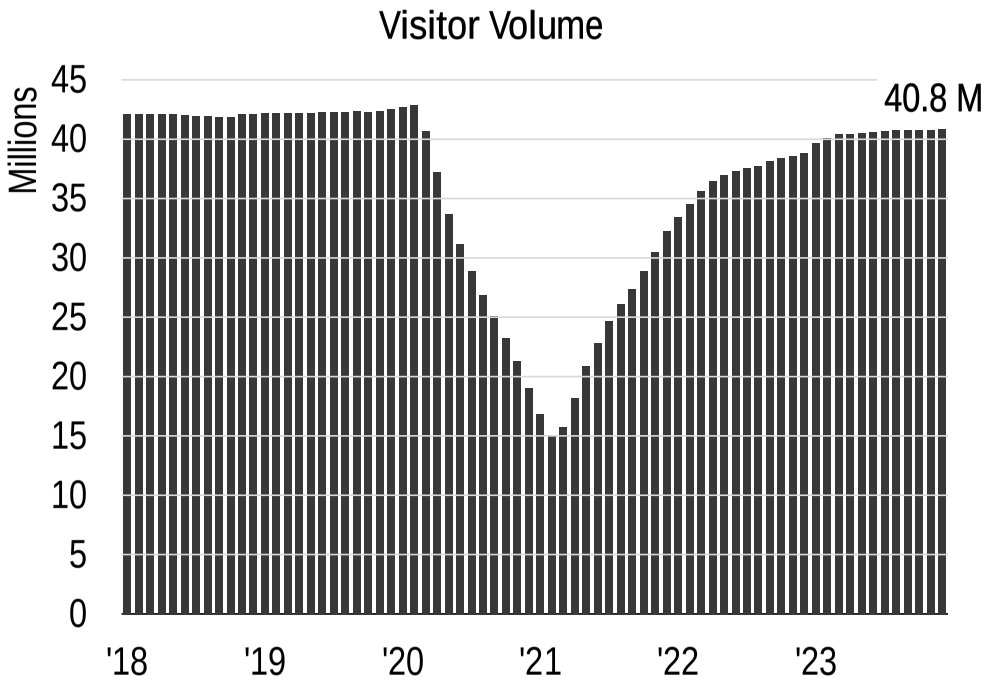


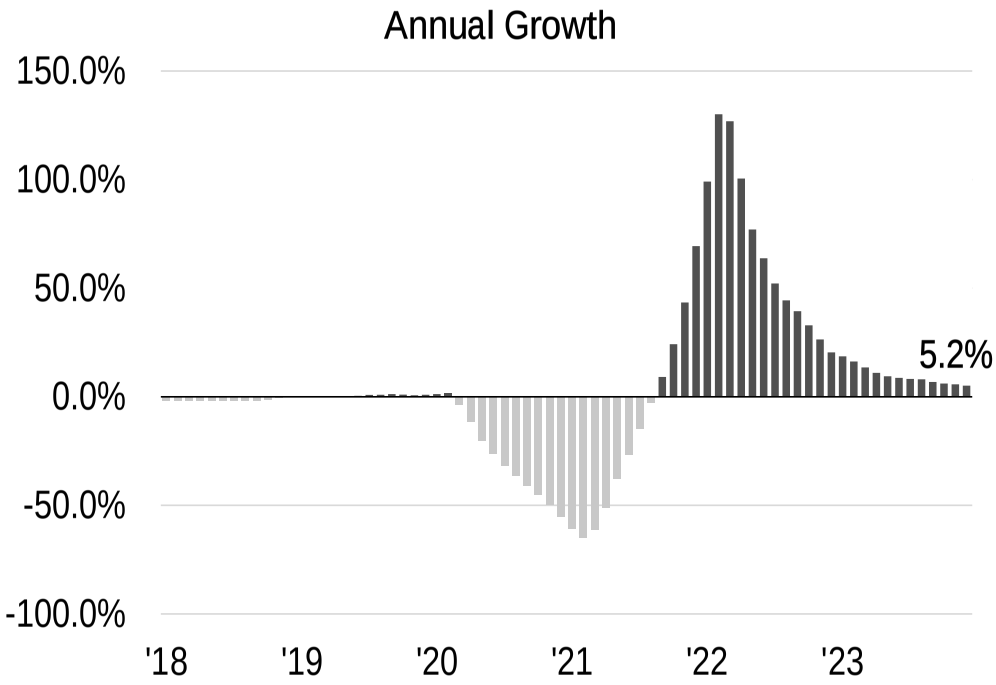
Source: Las Vegas Convention and Visitors Authority, Applied Analysis

Tourism Industry

Southern Nevada | Visitor Volume

Visitor volume in Southern Nevada continued to recover in 2023, reaching 40.8 million. The continued recovery of the convention and international segments will be critical for a return to pre-pandemic visitation levels.



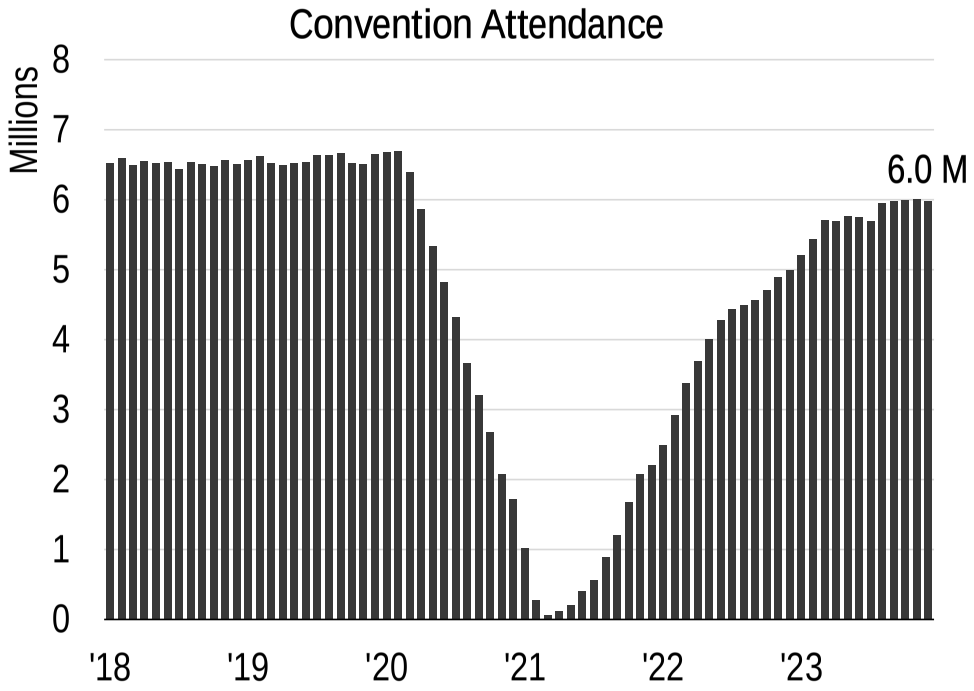


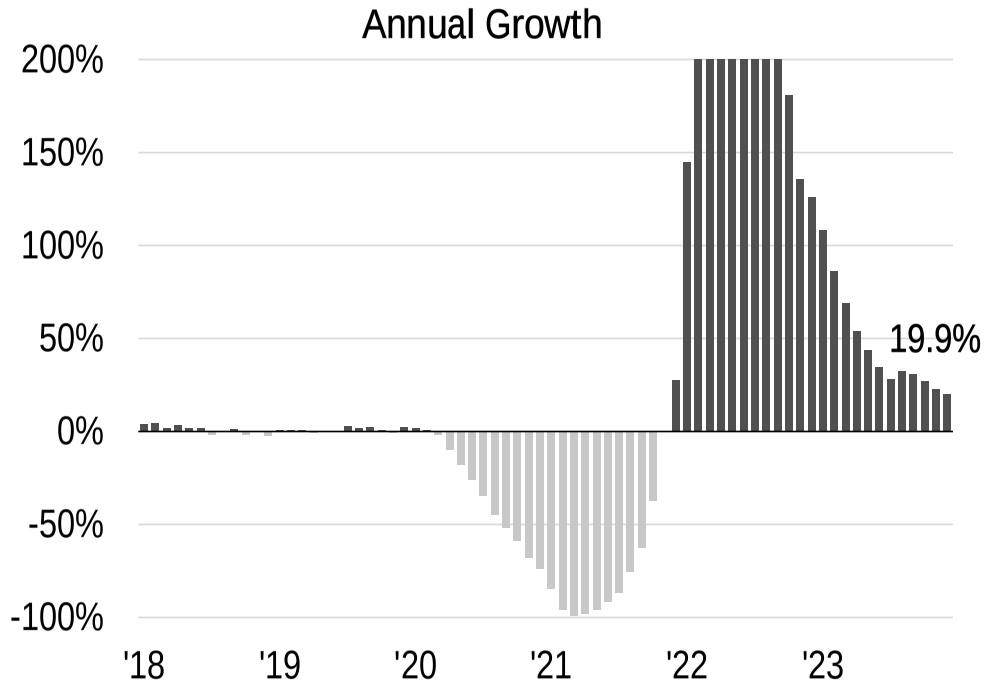
Source: Las Vegas Convention and Visitors Authority. Note: Data presented shows trailing 12-month totals.

Tourism Industry

Southern Nevada | Convention Attendance

Convention attendance bounced back to just over 6 million for the first time since the pandemic. Overall, total convention attendance remained below the pre-pandemic 6.5 million mark.



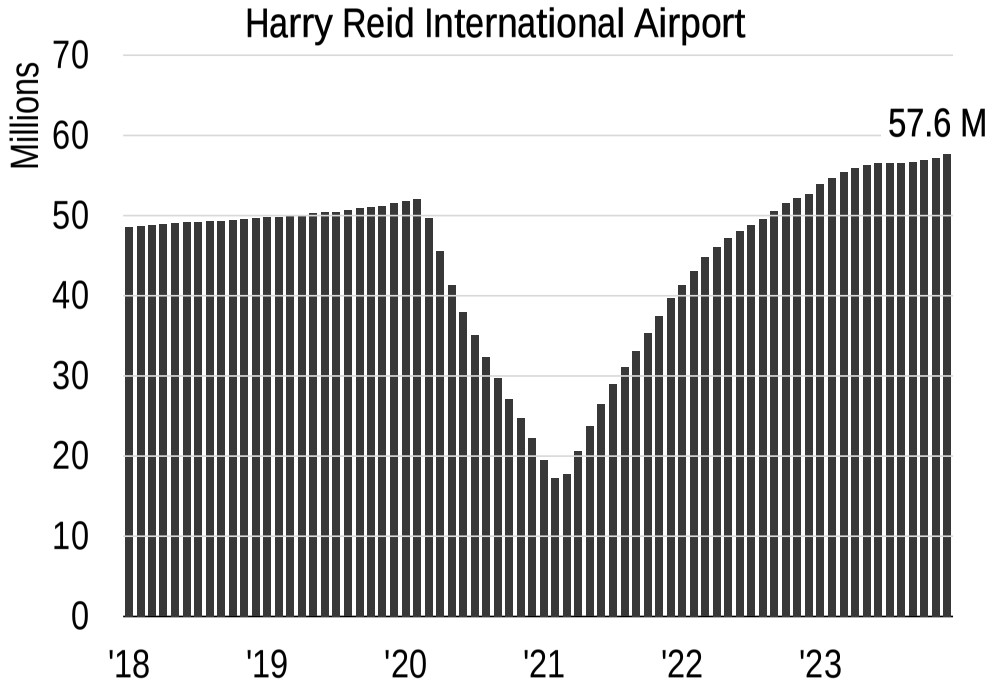


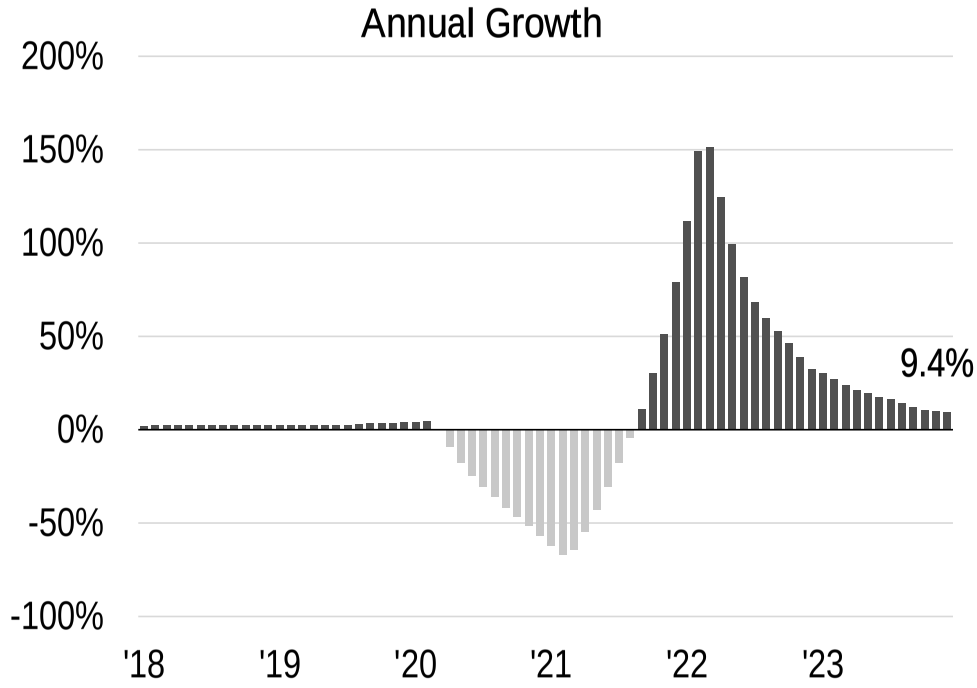
Source: Las Vegas Convention and Visitors Authority. Note: Data presented shows trailing 12-month totals. Vertical axis adjusted for data clarity.

Tourism Industry

Southern Nevada | Airport Passenger Counts

Harry Reid International Airport set an annual record with 57.6 million passengers in 2023. Plans for a supplemental airport south of Las Vegas are moving forward to accommodate the rapid growth of air travel through Southern Nevada.





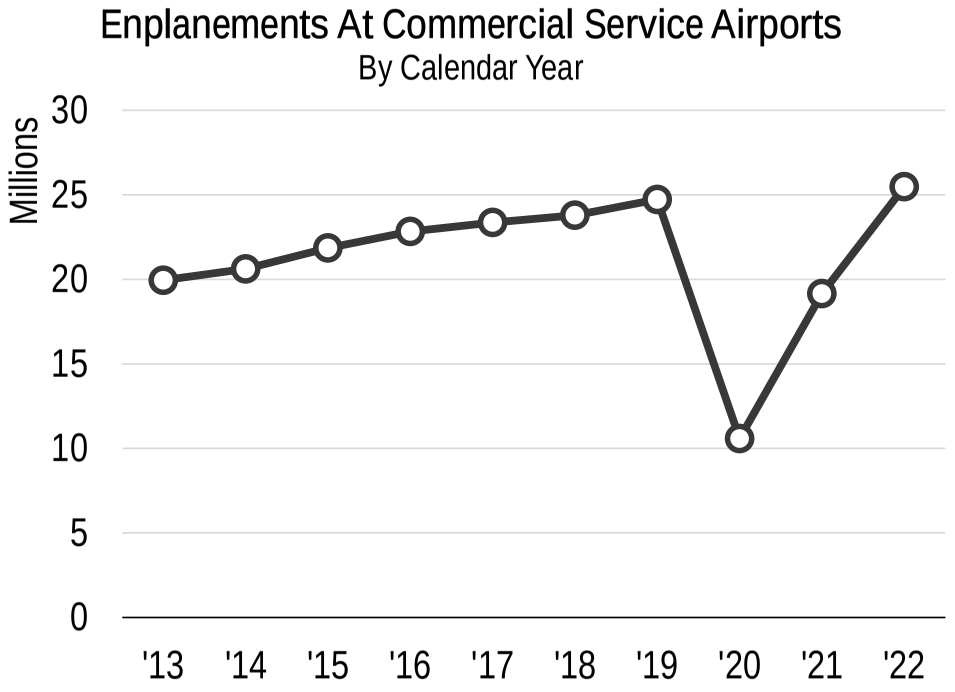
Source: Las Vegas Convention and Visitors Authority. Note: Data presented shows trailing 12-month totals.

Tourism Industry

Enplanements

Harry Reid International Airport remained among the nation's busiest airports in 2022, ranking seventh in total number of enplaned passengers.

Rank	Airport	Passengers (Millions)	Annual Growth
1	Atlanta (ATL)	45.4	23.8%
2	Dallas/Fort Worth (DFW)	35.3	17.8%
3	Denver (DEN)	33.7	17.9%
4	Chicago-O'Hare (ORD)	33.1	25.7%
5	Los Angeles (LAX)	32.3	36.6%
6	New York (JFK)	26.9	77.8%
7	LAS VEGAS (LAS)	25.3	33.0%
8	Orlando (MCO)	24.4	24.7%
9	Miami (MIA)	23.7	36.9%
10	Charlotte (CLT)	23.1	10.5%

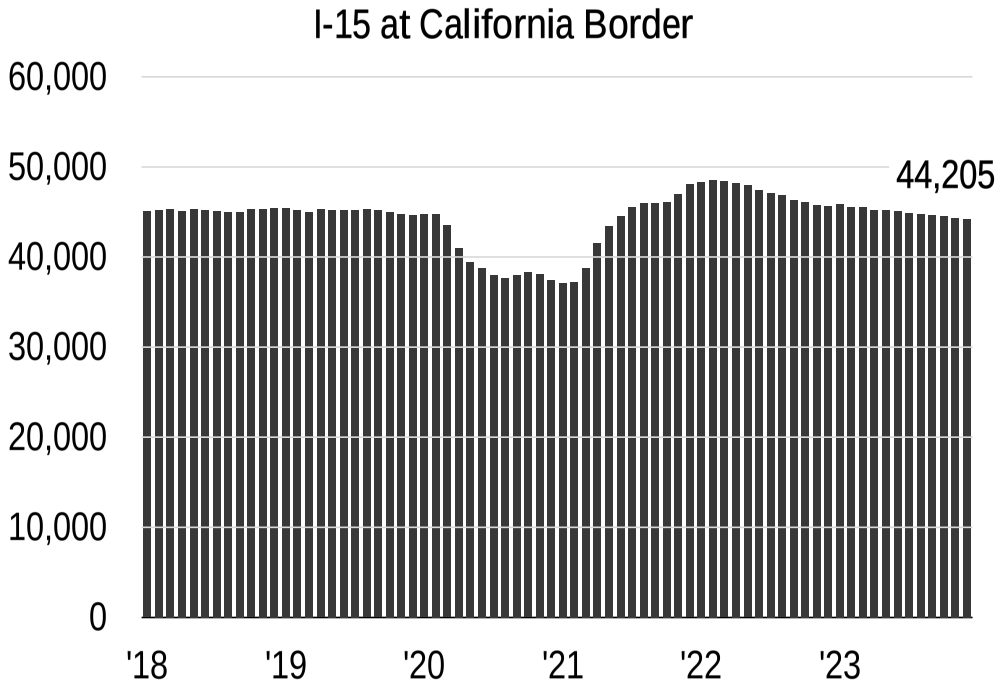


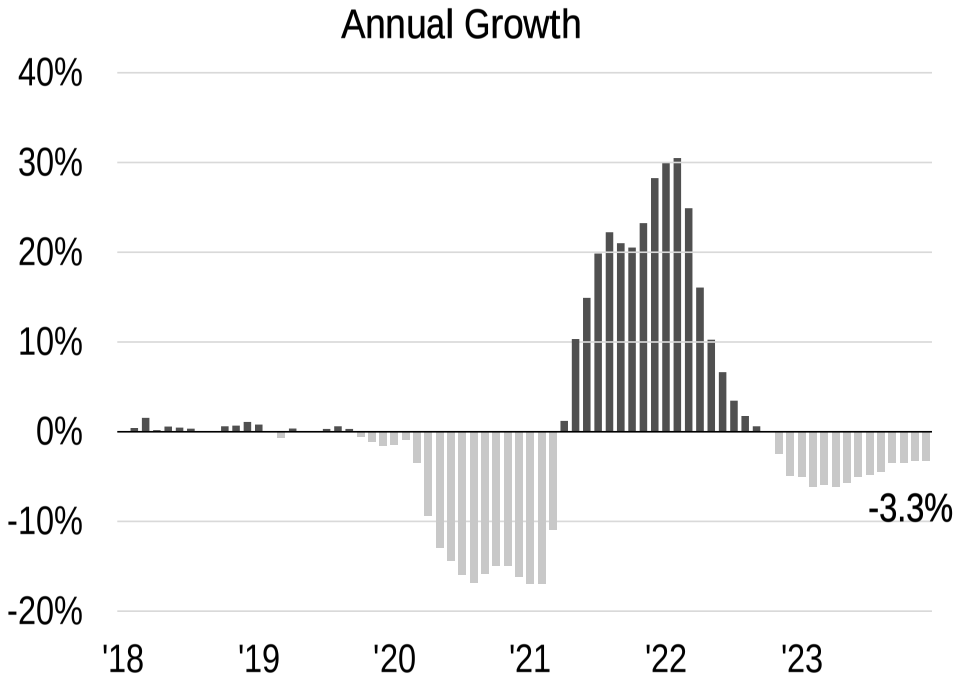
Source: Federal Aviation Administration, Air Carrier Activity Information System

Tourism Industry

Southern Nevada | Daily Auto Traffic

Highway traffic at the California border has declined steadily since peaking in early 2022. Traffic surged during the pandemic as resorts catered to the drive-in leisure segment amid air travel reductions and dips in convention and international travel.



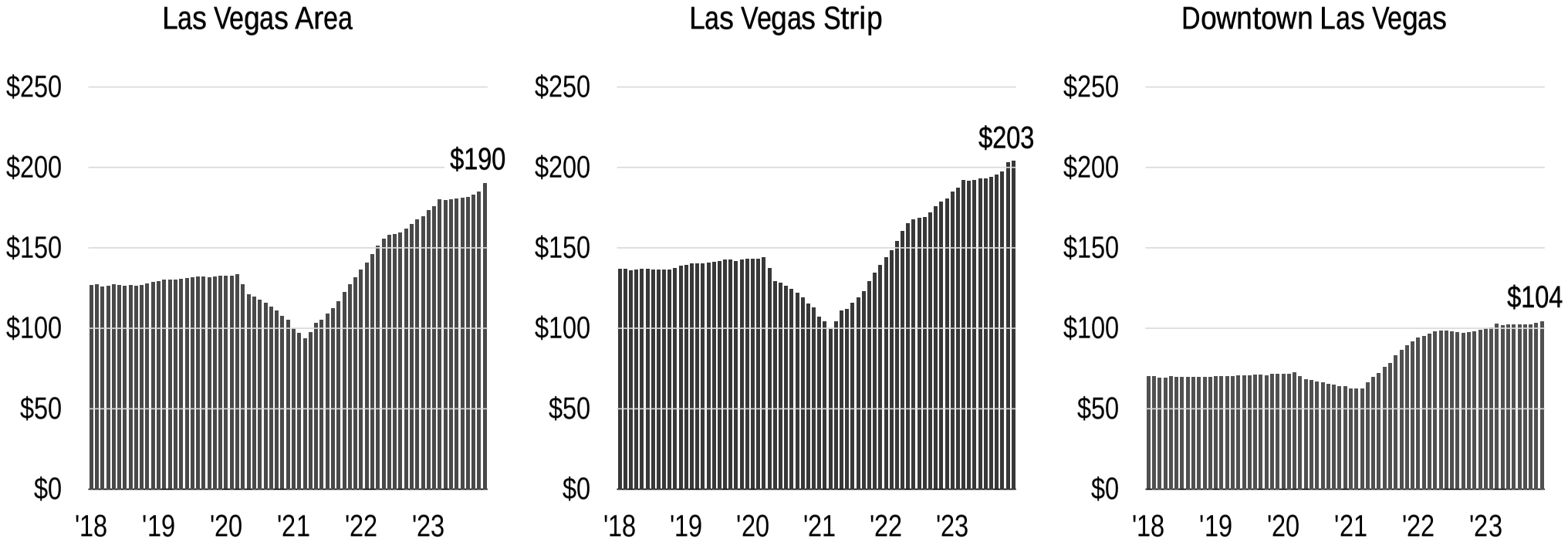


Source: Las Vegas Convention and Visitors Authority. Note: Data presented show trailing 12-month totals.

Tourism Industry

Southern Nevada | Average Daily Room Rate

Room rates across Southern Nevada surged over the past three years to reach new highs in 2023. Higher demand during sporting events such as Formula 1 and the Super Bowl and concerts such as Taylor Swift helped elevate room pricing.

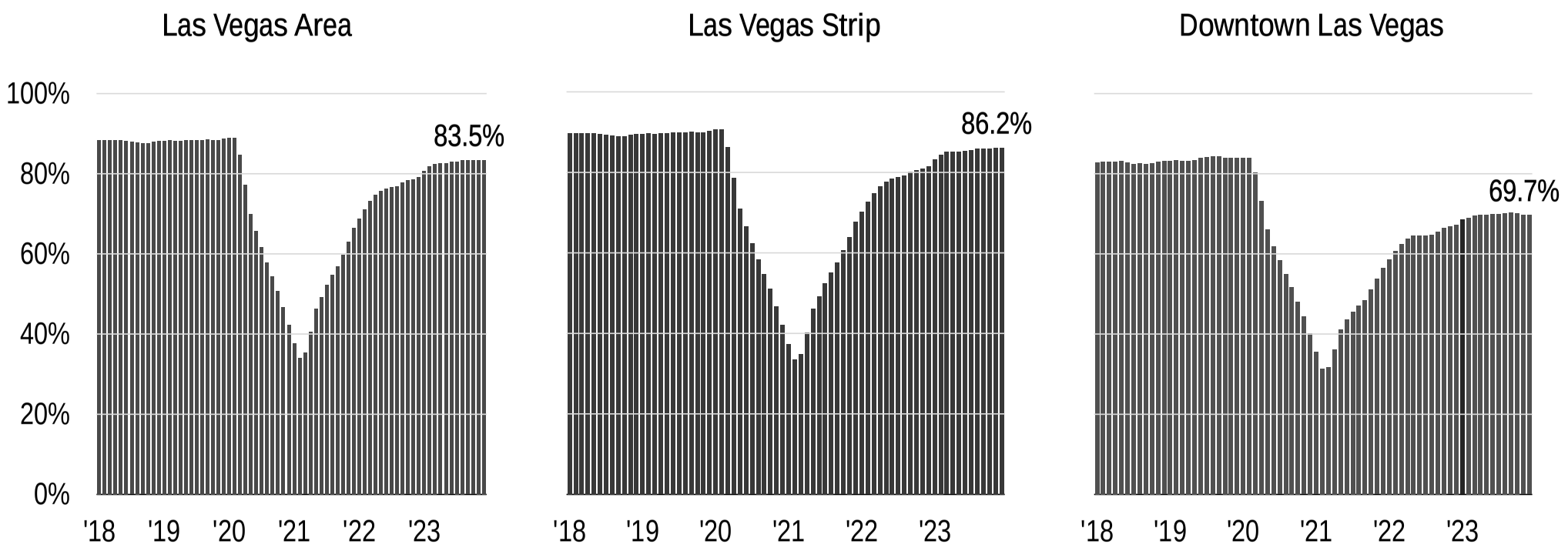


Source: Las Vegas Convention and Visitors Authority. Note: Data presented show trailing 12-month averages.

Tourism Industry

Southern Nevada | Hotel/Motel Occupancy Rate

Room occupancy rates continued to recover throughout Southern Nevada in 2023 but remained short of pre-pandemic levels.

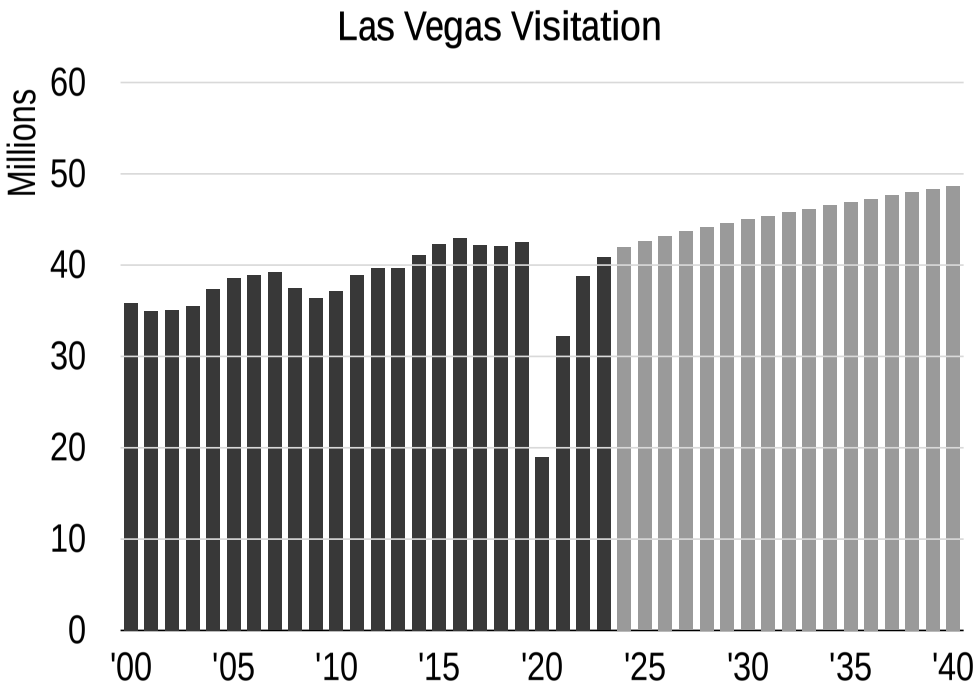


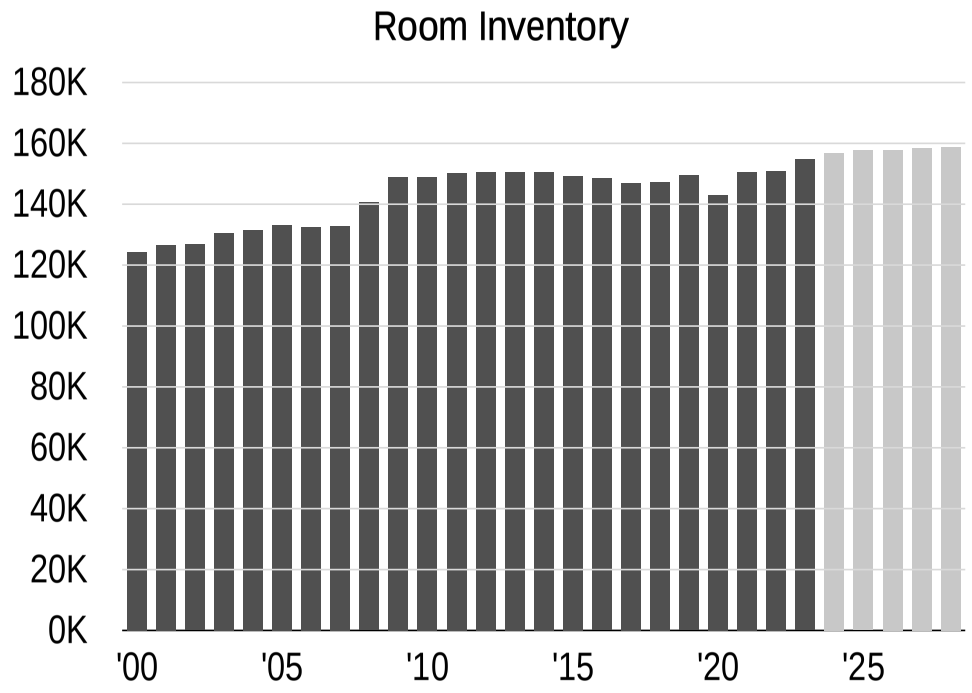
Source: Las Vegas Convention and Visitors Authority. Note: Data presented show trailing 12-month averages.

Tourism Projections

Southern Nevada

Based on conservative growth projections, annual visitation to Las Vegas could approach 50 million in about 15 years. Visitation growth depends on room inventory, and more than 4,000 new rooms are in the pipeline over the next five years.





Source: Las Vegas Convention and Visitors Authority, Applied Analysis


T-Mobile Arena (2016)
T··Mobile·ARENA
Allegiant Stadium (2020)
allegiant stadium
WELCOME TO ALLEGIANT STADIUM
TEAM STORE
NORTH GATE
Over the past decade, billions of dollars in private and public investment in new venues have ushered in a new era of sports and entertainment in Southern Nevada.
Sphere (2023)
Formula 1 Pit Building (2023)
PADDOCK CLUB


600+
EVENTS IN 2023

Taylor Swift's "The Eras Tour"

MARCH 2023 AT ALLEGIANT STADIUM

NBA Summer League

JULY 2023 AT THOMAS & MACK CENTER AND COX PAVILION

STANLEY CUP FINALS

JUNE 2023 AT T-MOBILE ARENA

NVEnergy 2024 ECONOMIC OVERVIEW AND DEVELOPMENT PIPELINE APPLIED ANALYSIS

BEYONCE'S "RENAISSANCE TOUR"

AUGUST 2023 AT ALLEGIANT STADIUM

Las Vegas Grand Prix

NOVEMBER 2023 ON THE LAS VEGAS STRIP

NVEnergy 2024 ECONOMIC OVERVIEW AND DEVELOPMENT PIPELINE APPLIED ANALYSIS

Super Bowl LVIII

FEBRUARY 2024 AT ALLEGIANT STADIUM

NCAA Final Four

APRIL 2027 AT ALLEGIANT STADIUM

Las Vegas A's

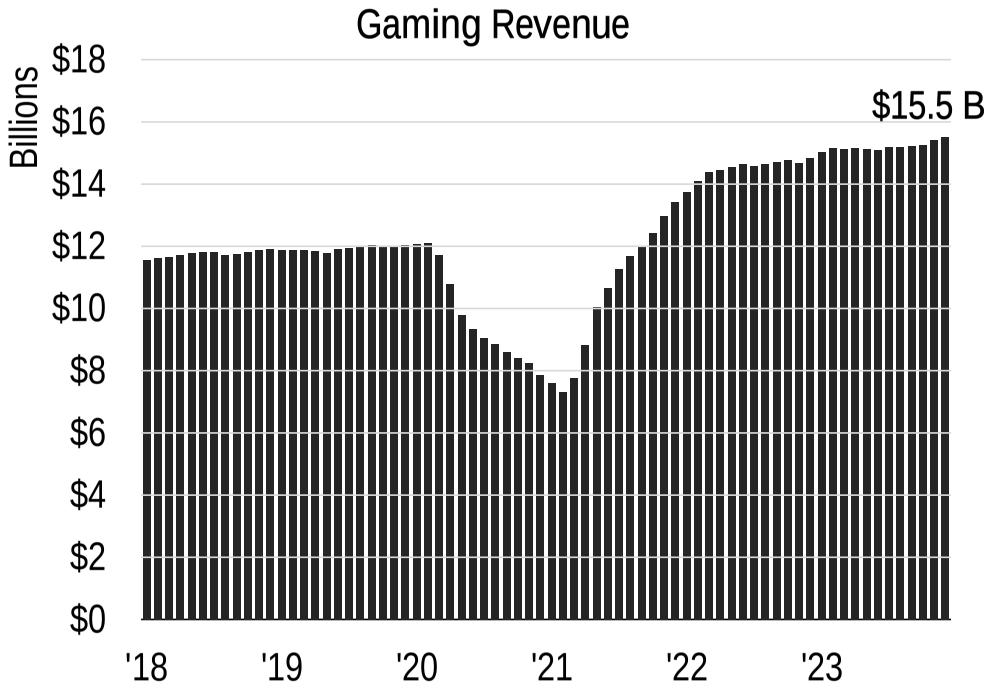
2028

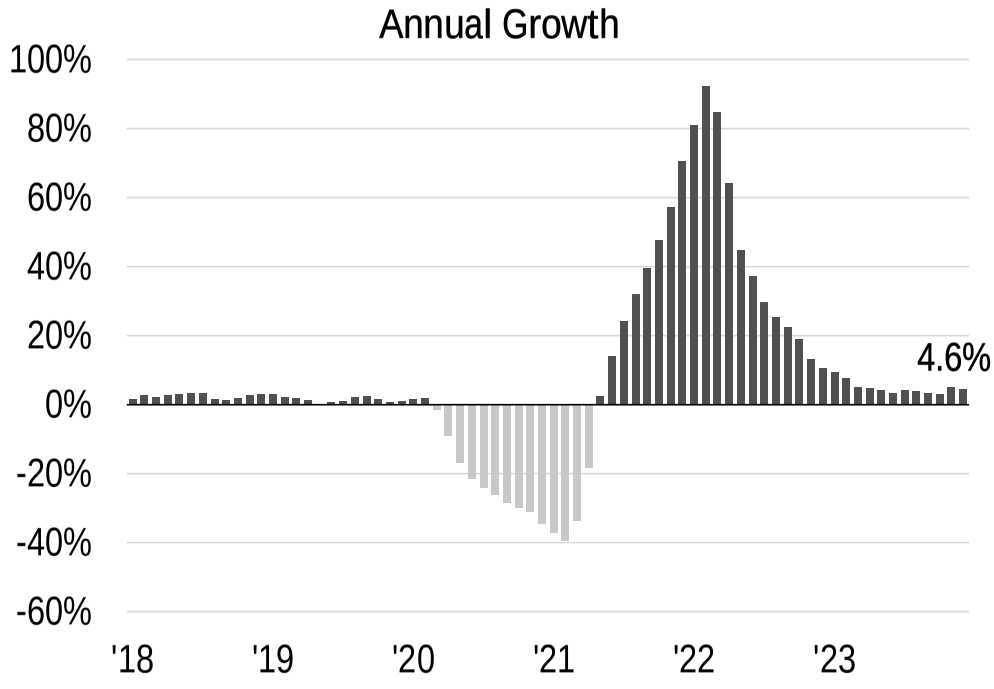
NVEnergy 2024 ECONOMIC OVERVIEW AND DEVELOPMENT PIPELINE APPLIED ANALYSIS

Tourism Industry

Nevada | Gaming Revenue

Southern Nevada's strong events schedule in 2023 helped Nevada set an annual record for gaming revenue at $15.5 billion.



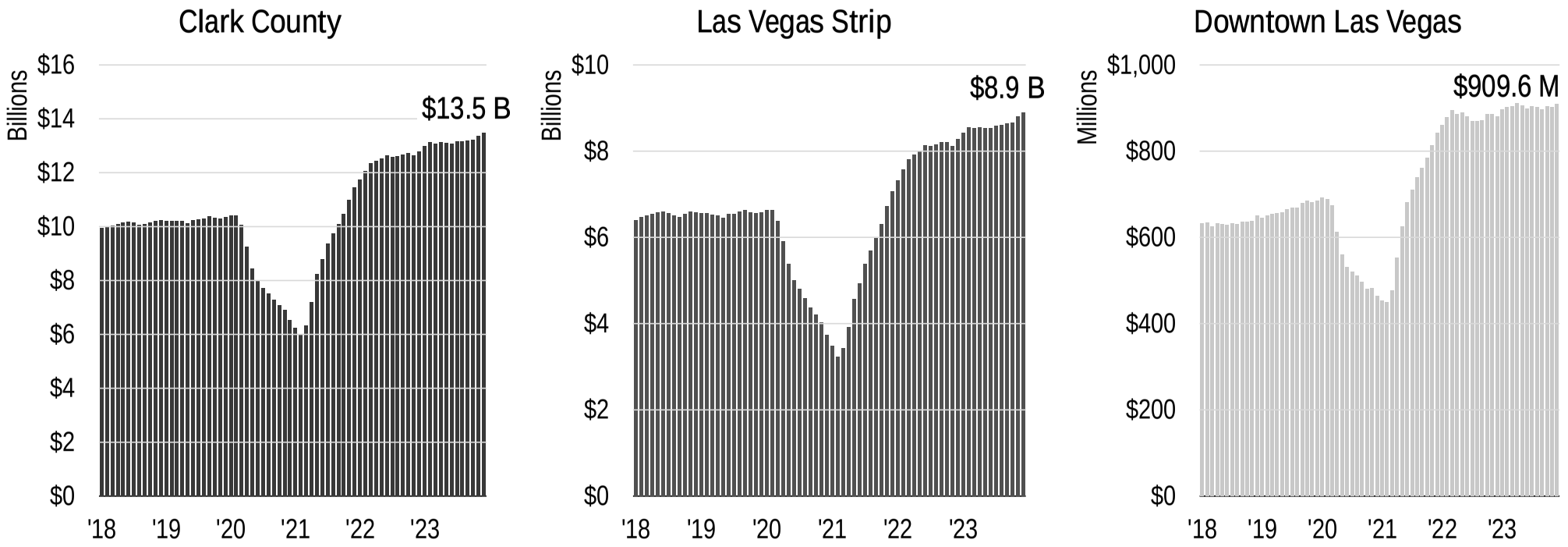


Source: Nevada Gaming Control Board. Note: Data presented show trailing 12-month totals.

Tourism Industry

Southern Nevada | Gaming Revenue

Fueled by gaming activity on the Las Vegas Strip, gaming revenue in Southern Nevada set a record of $13.5 billion in 2023.



Source: Nevada Gaming Control Board. Note: Data presented show trailing 12-month totals.

Tourism in Northern Nevada

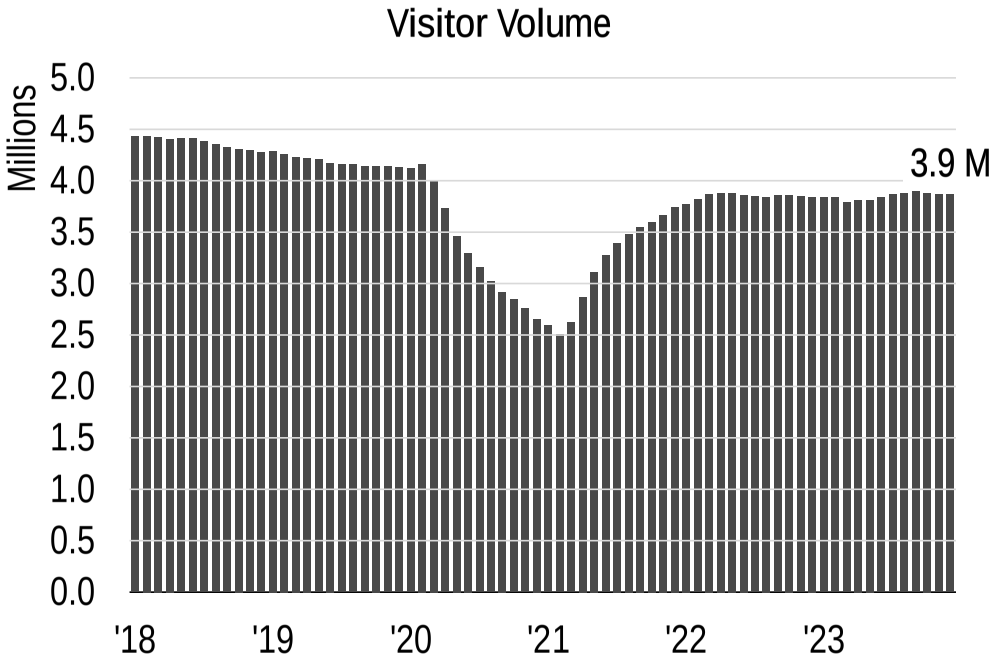
Northern Nevada's economy depends less on tourism than Southern Nevada,
yet the tourism industry is an important part of the regional economy.
In 2023, the industry generated $3.1 billion in total economic impact across the region.

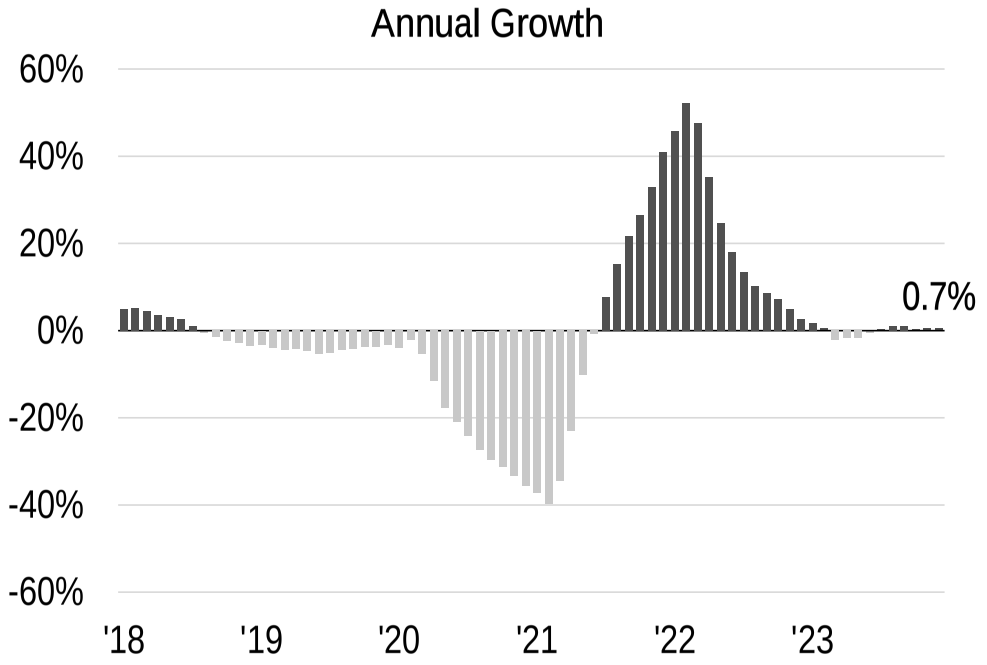
Source: Reno-Sparks Convention and Visitors Authority

Tourism Industry

Northern Nevada | Visitor Volume

Visitor volume in Northern Nevada has recovered some since the pandemic, and while it has not returned to prior levels, it has reversed the steady decline reported in the years before 2020.



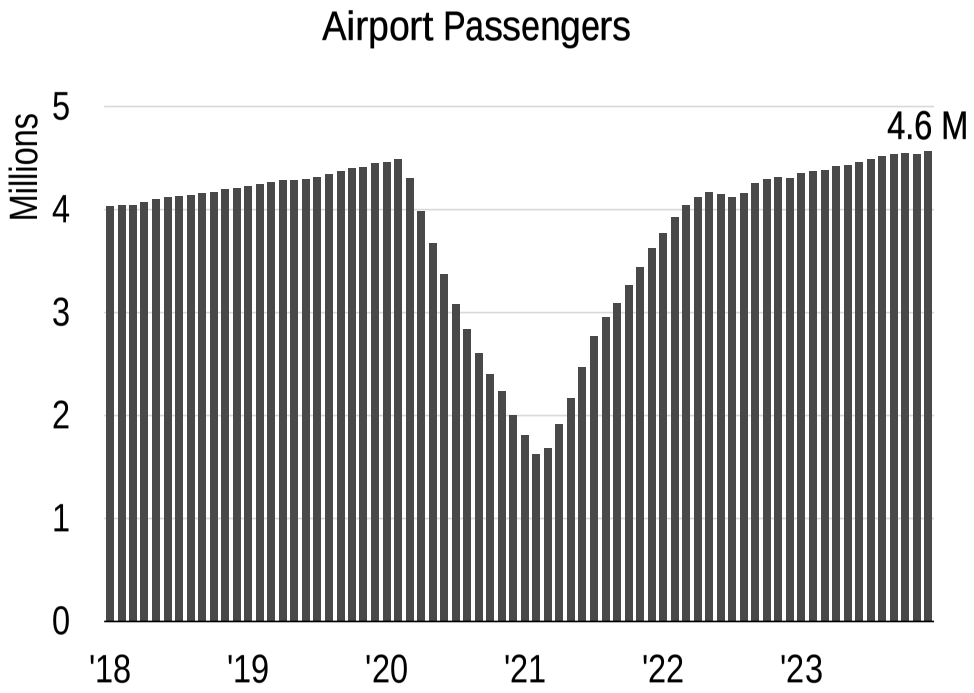


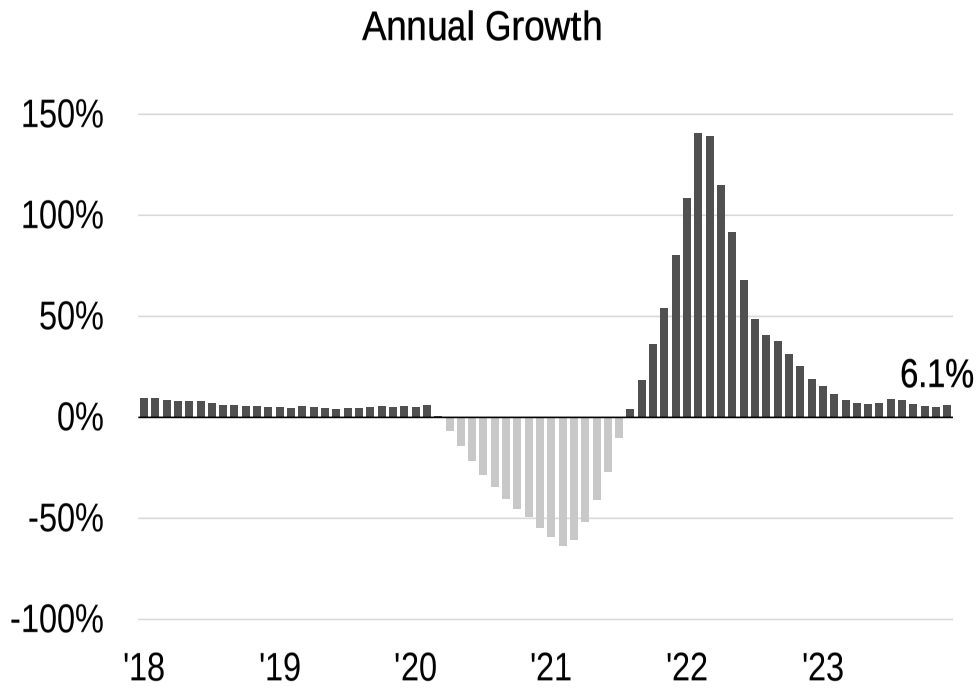
Source: Reno-Tahoe Convention and Visitors Authority. Note: Data presented show trailing 12-month totals.

Tourism Industry

Northern Nevada | Airport Passenger Counts

Passenger traffic at Reno-Tahoe International Airport grew to a record of 4.5 million in 2023, capping 27 consecutive months of increases where annual growth rates never fell below 5 percent.



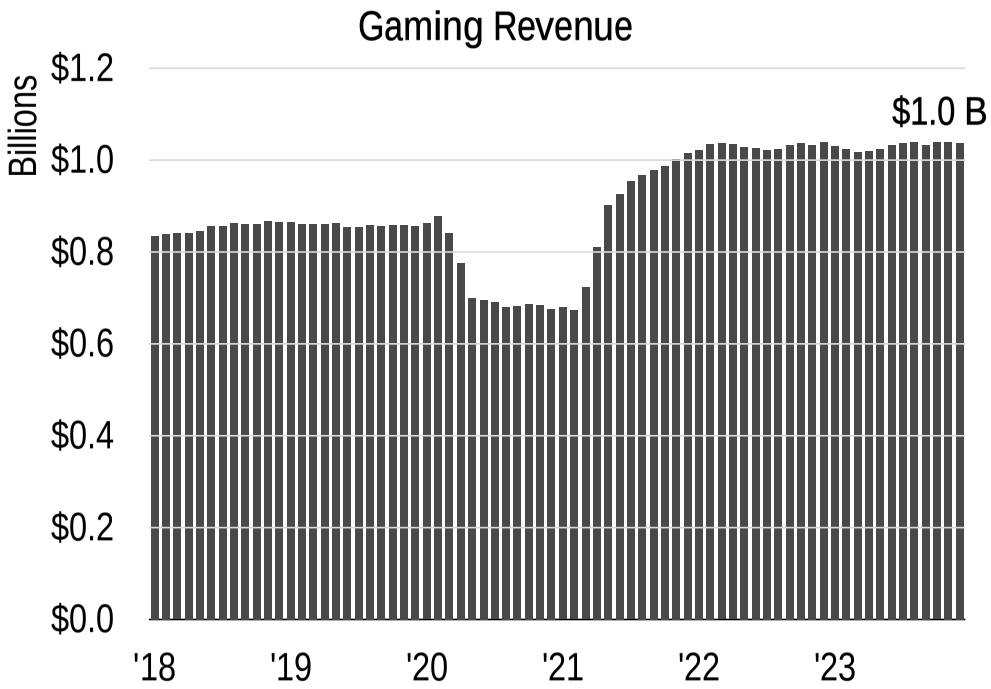


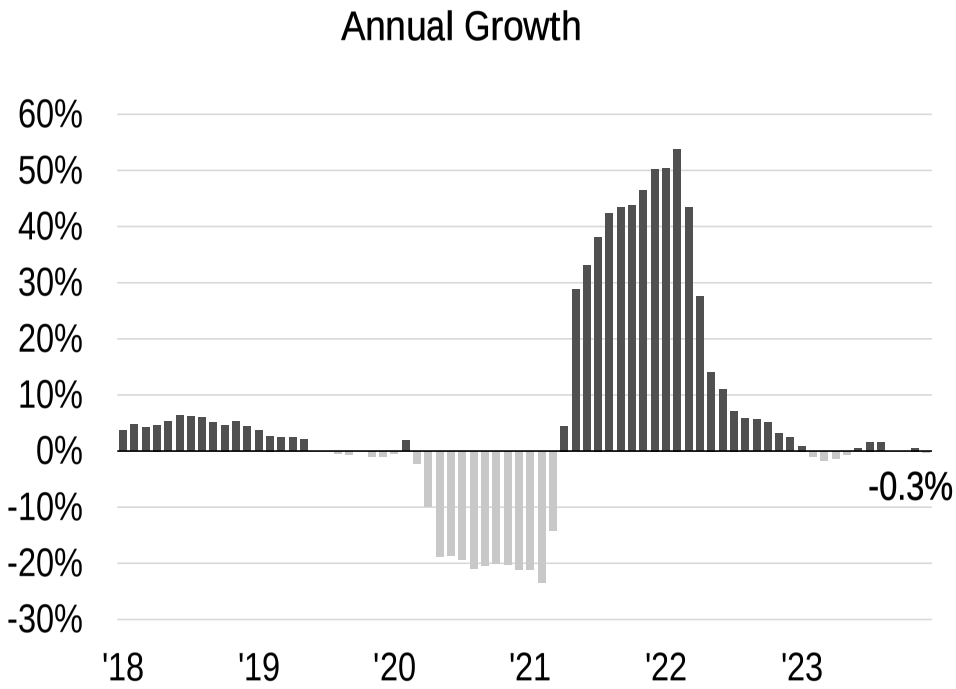
Source: Reno-Tahoe International Airport. Note: Data presented show trailing 12-month totals.

Tourism Industry

Northern Nevada | Gaming Revenue

Gaming revenue in Northern Nevada has consistently exceed pre-pandemic levels while remaining stable over the past year.





Source: Nevada Gaming Control Board. Note: Data presented show trailing 12-month totals.

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

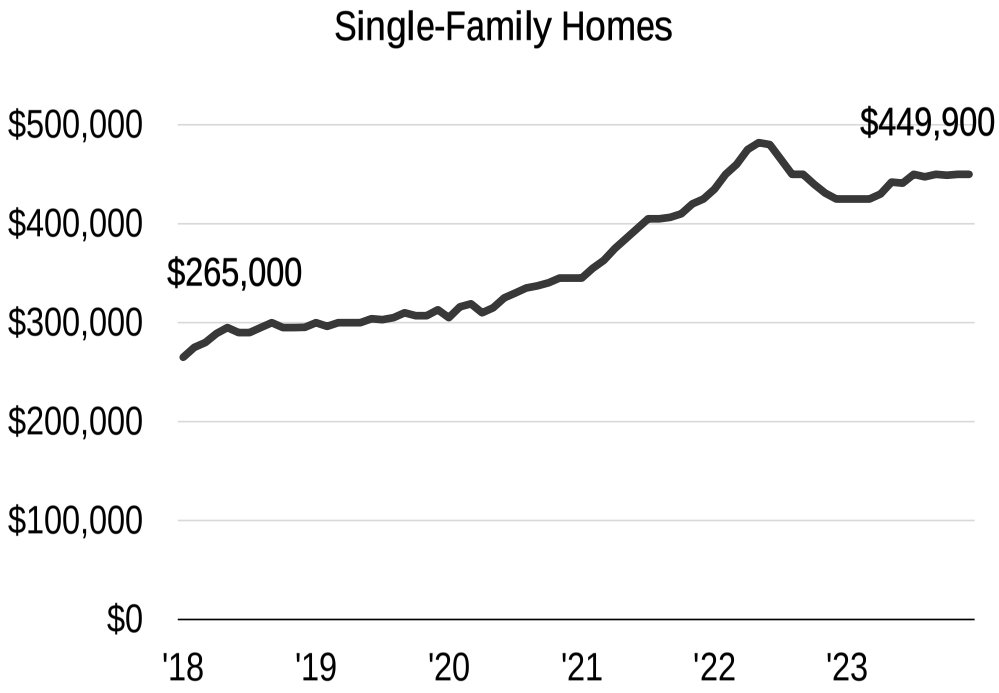
POPULATION AND MIGRATION

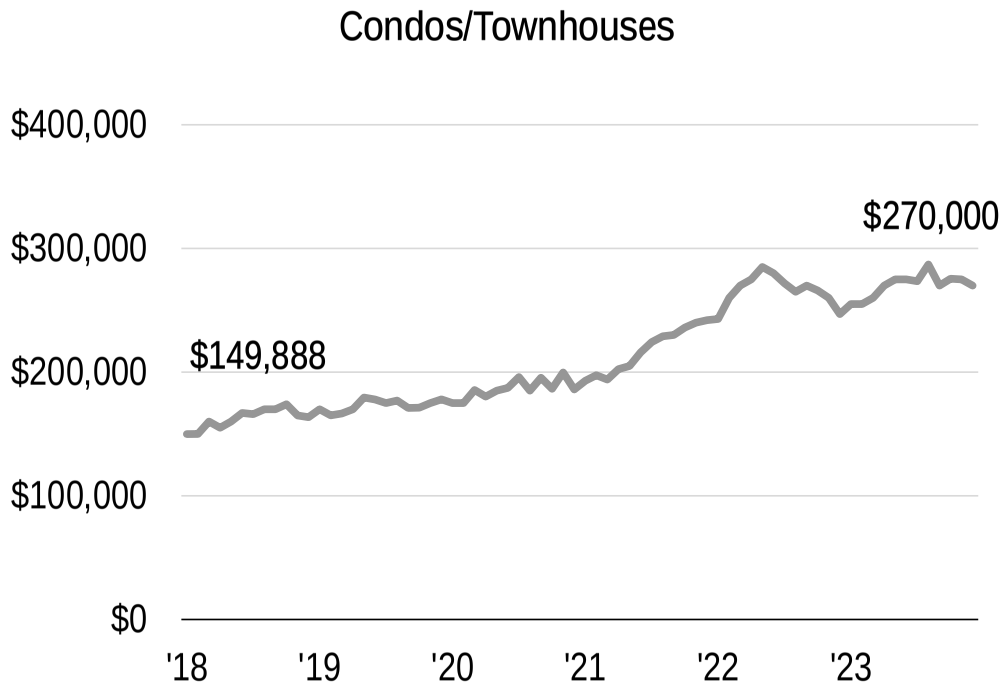
DEVELOPMENT PIPELINE

Resale Home Prices

Southern Nevada

Resale home prices in Southern Nevada spiked amid rising demand and record-low interest rates after the pandemic. The rapid price increases cooled in 2023 as interest rates climbed.



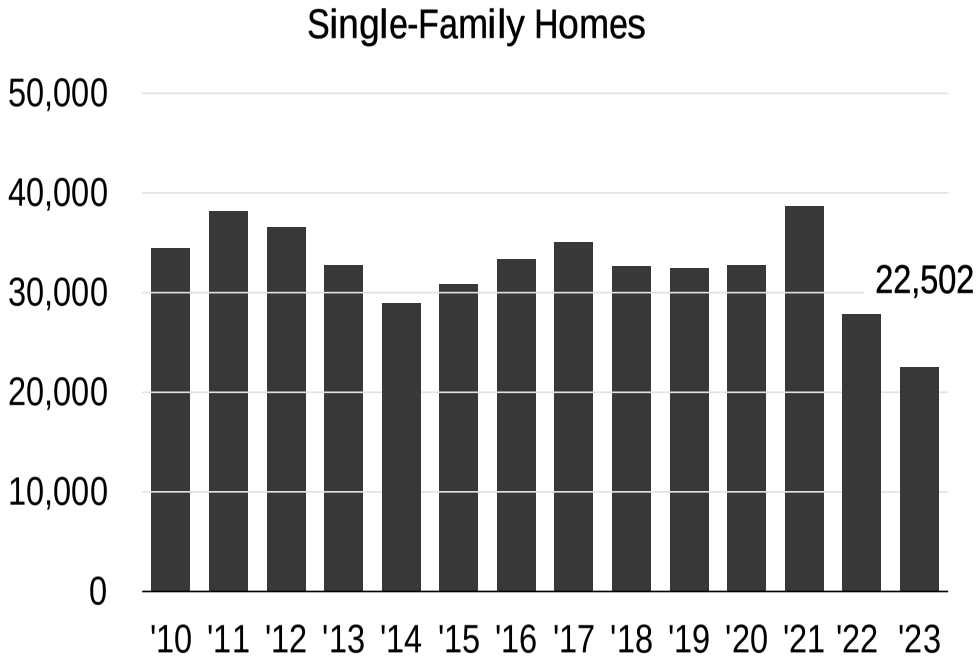


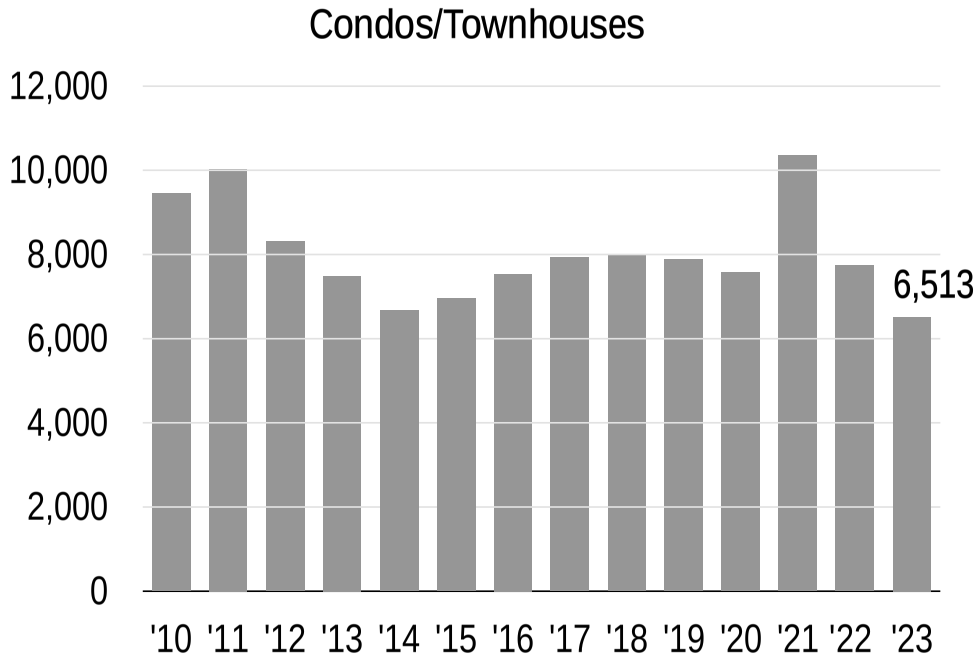
Source: Las Vegas Realtors

Resale Home Closings

Southern Nevada

Total resale closings for both single-family homes and condos or townhouses hit their lowest points in more than a decade as fast-rising interest rates in 2023 affected both supply and demand dynamics in the market.



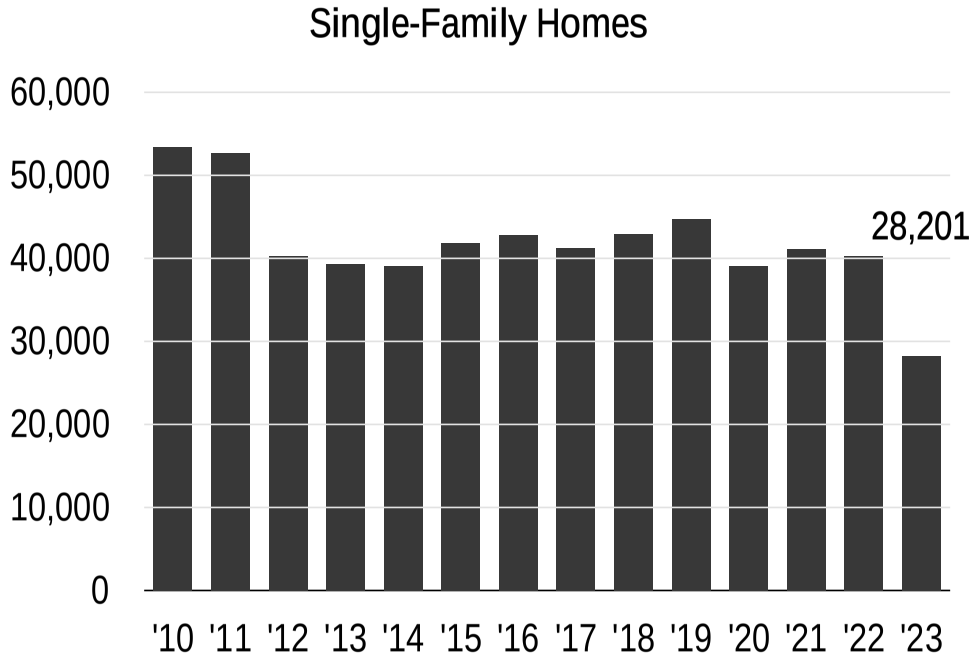


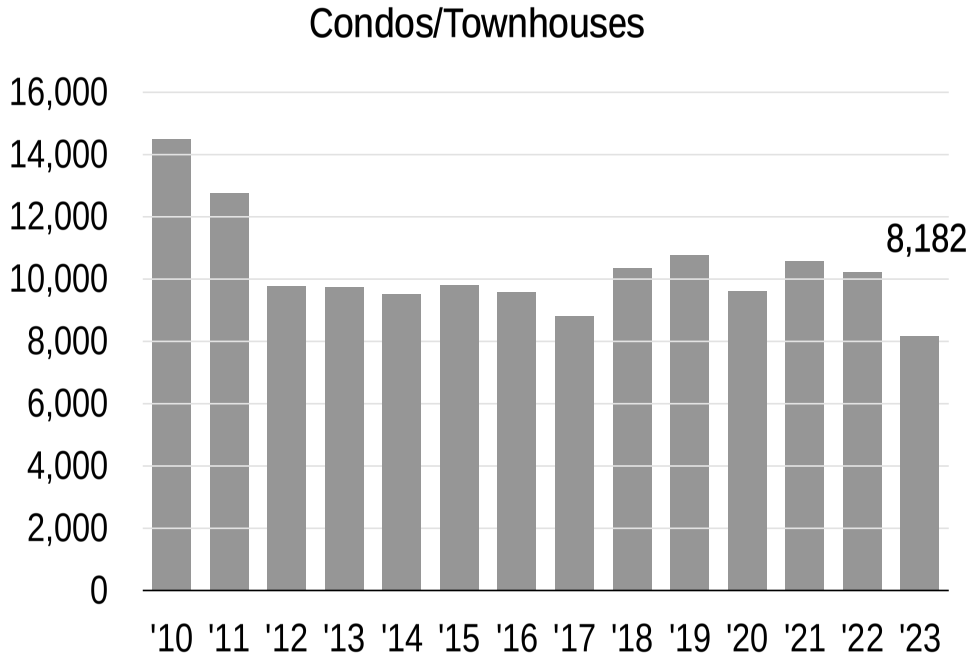
Source: Las Vegas Realtors

Resale Home New Listings

Southern Nevada

The drop in sales coincided with a collapse in new listings. More than 60 percent of Nevada mortgage holders locked in interest rates under 4 percent in recent years, creating a lock-in effect in 2023 as rates climbed over 7 percent.



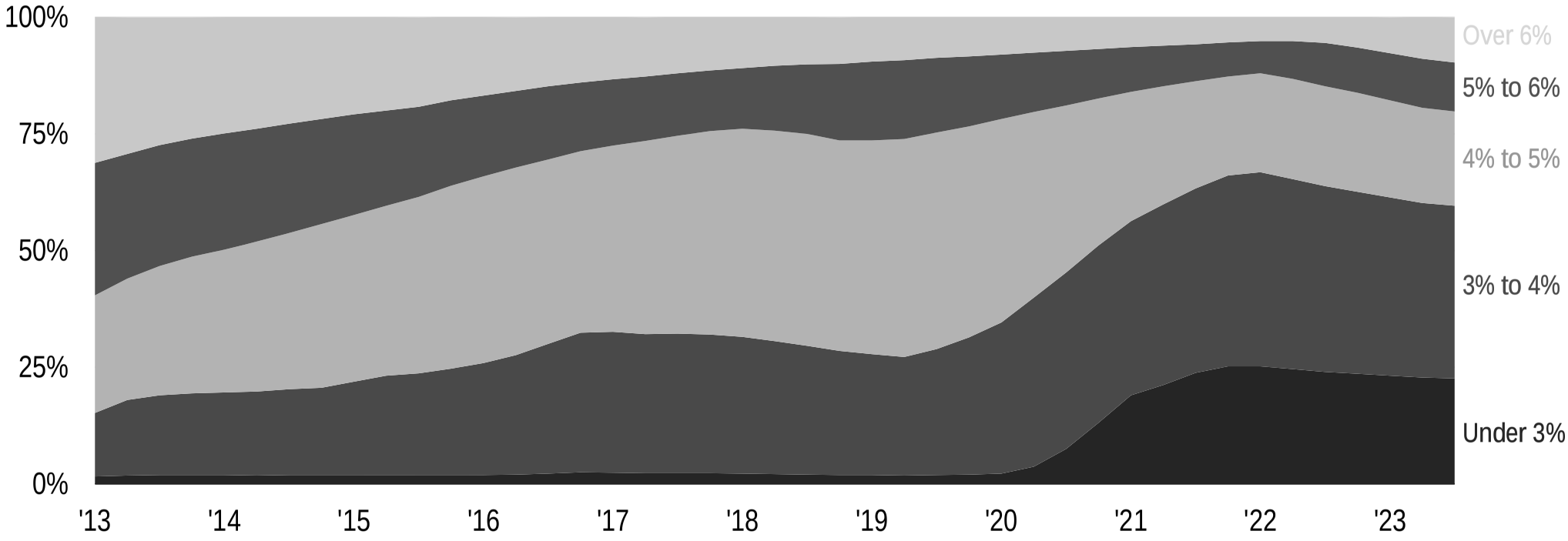


Source: Las Vegas Realtors. Note: Data presented shows year-end totals through December.

Rates on Existing Mortgages

Nevada

More than half of Nevada homeowners took advantage of historically low borrowing rates after the pandemic to lock in sub-4 percent rates. With rates now over 7 percent, those homeowners would face much higher interest costs with a new mortgage.



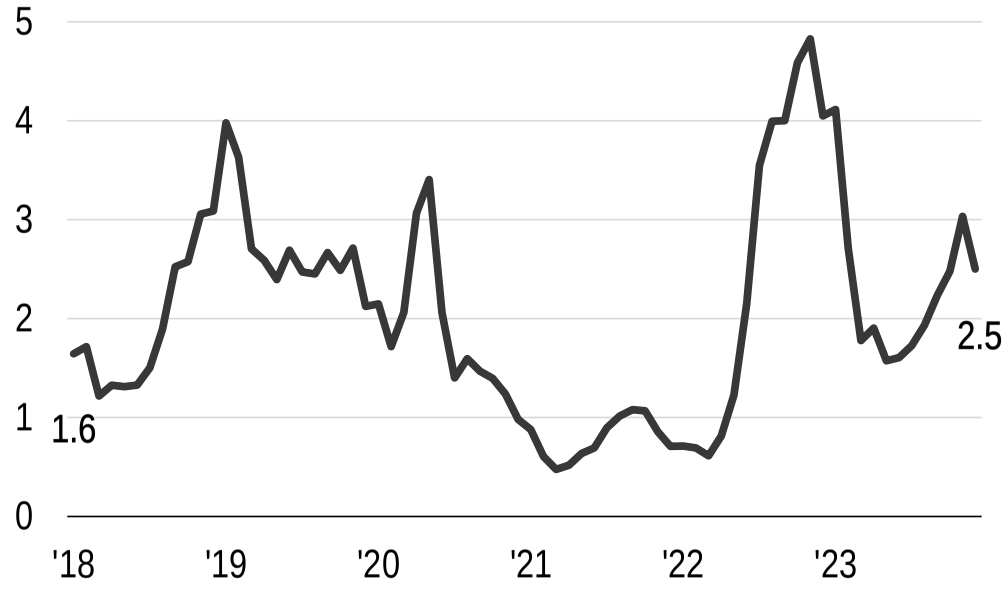
Source: Federal Housing Finance Agency

Months of Effective Inventory

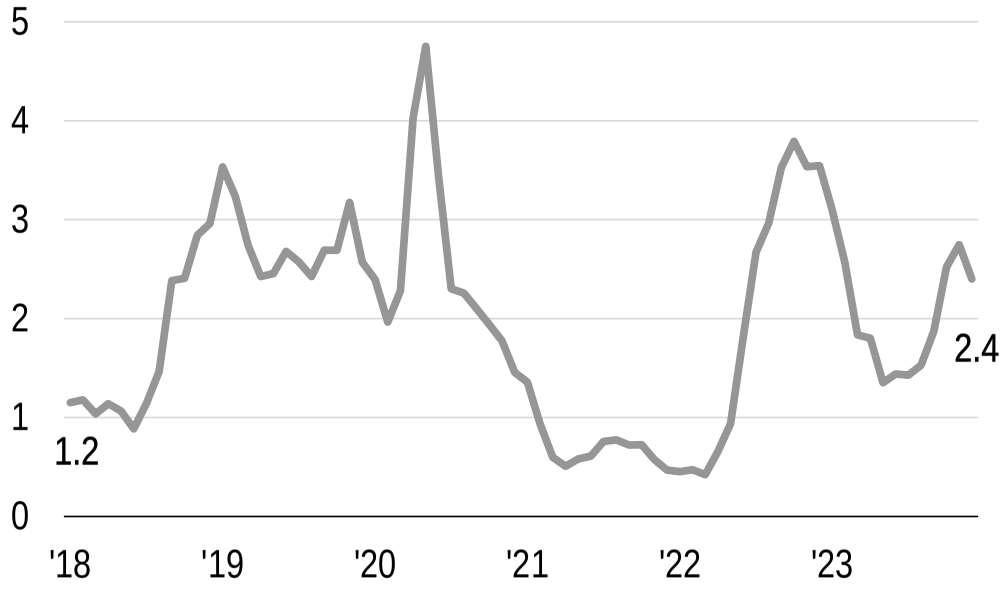
Southern Nevada

Effective inventory of homes has fluctuated wildly in recent years, including a spike early during the pandemic followed by one of the hottest markets in years. The market approached a more normalized level by the end of 2023.

Single-Family Homes



Condos/Townhouses

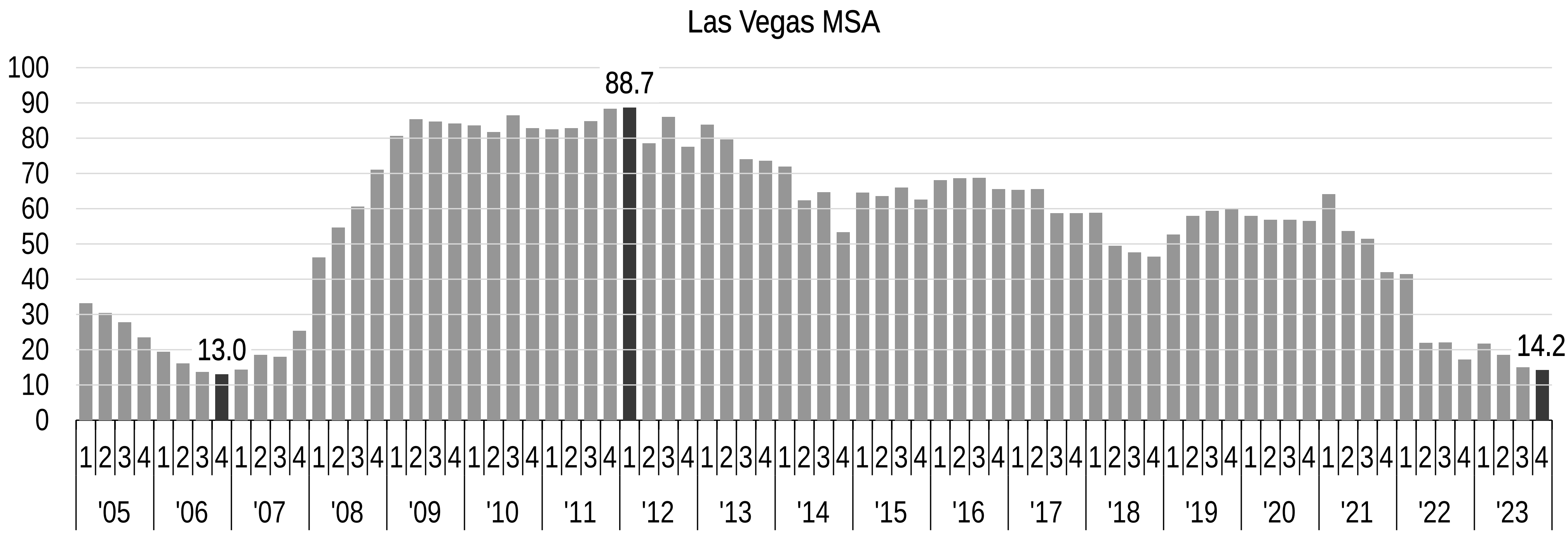


Source: Las Vegas Realtors

Housing Opportunity Index

Southern Nevada

Southern Nevada's housing opportunity index fell to its lowest level in 17 years. The index indicates that less than 15 percent of homes in the region are affordable for a household with median income.

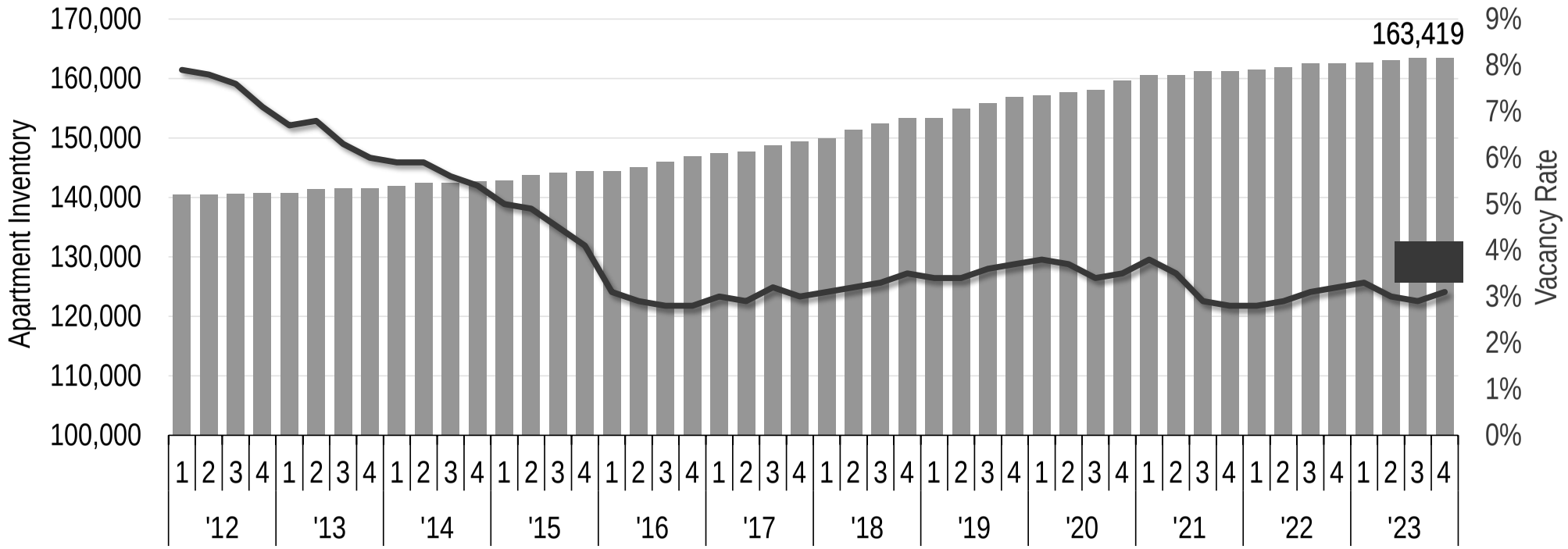


Source: National Association of Home Builders

Apartment Inventory & Vacancy Rate

Southern Nevada

The apartment vacancy rate has hovered between 3 and 4 percent since 2016. Inventory has increased steadily over that time, suggesting a long-term market balance between supply and demand.

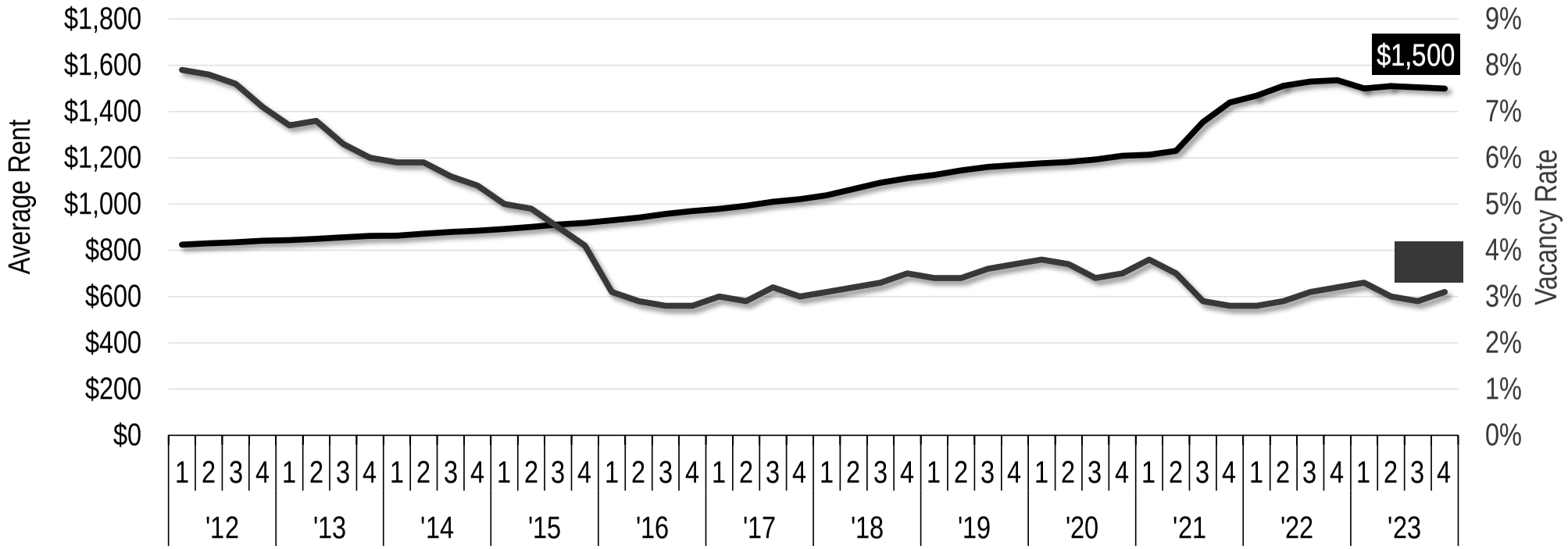


Source: REIS

Average Rent & Vacancy Rate

Southern Nevada

Average apartment rents in Southern Nevada increased significantly in mid-2021 during a period of rising inflation and tightening vacancy rates. Both rents and vacancy rates have generally stabilized over the past year.

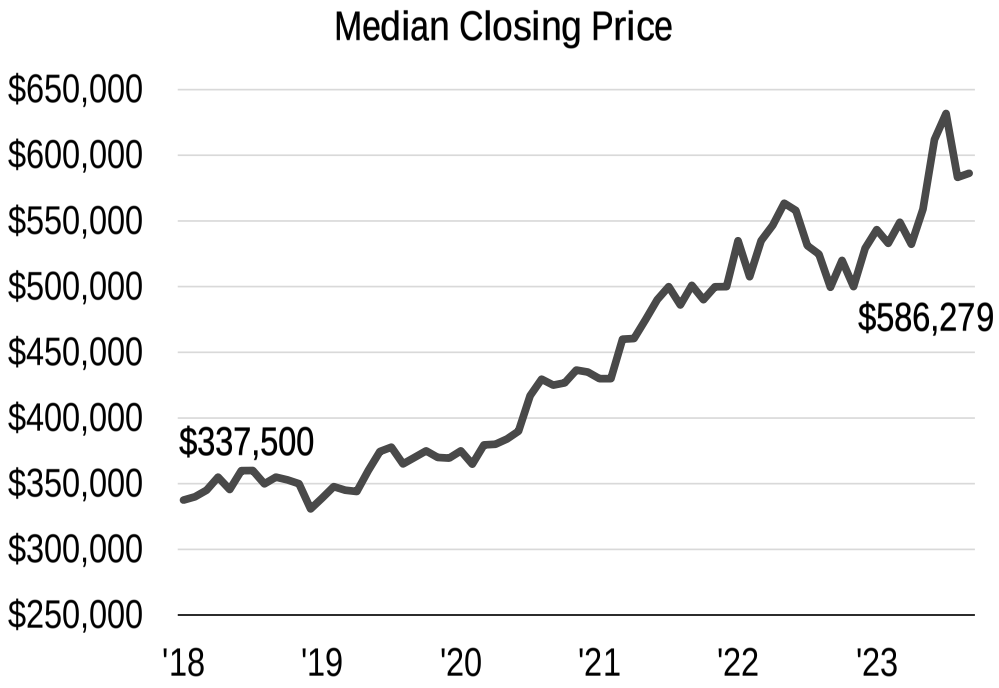


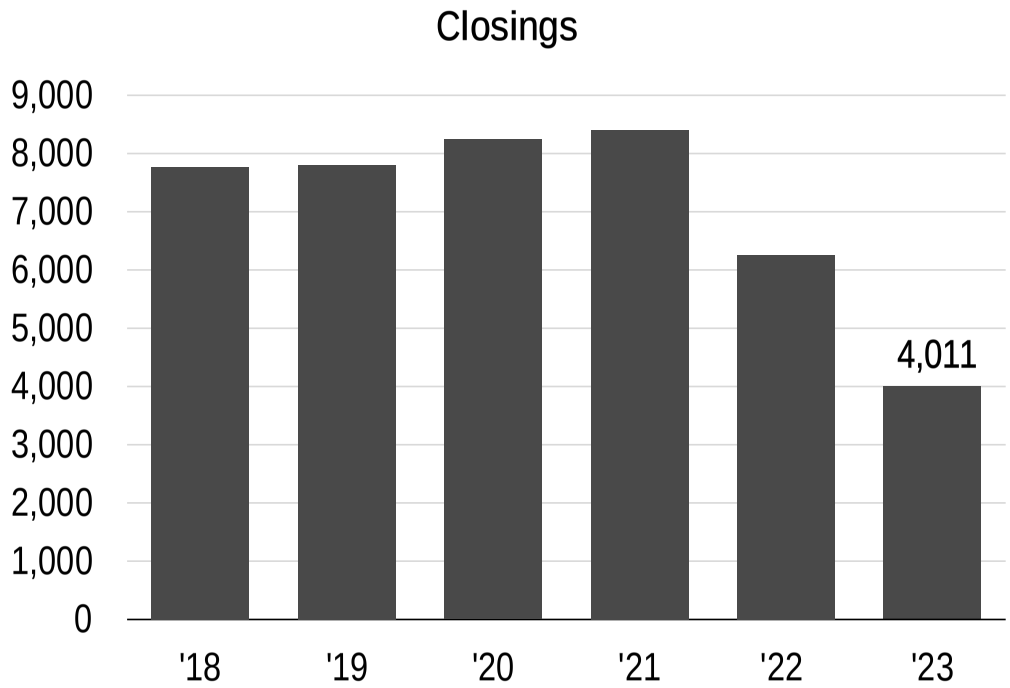
Source: REIS

Existing Homes

Northern Nevada

Resale housing prices have steadily climbed in Northern Nevada even as sales activity slowed to 4,000 units in 2023.



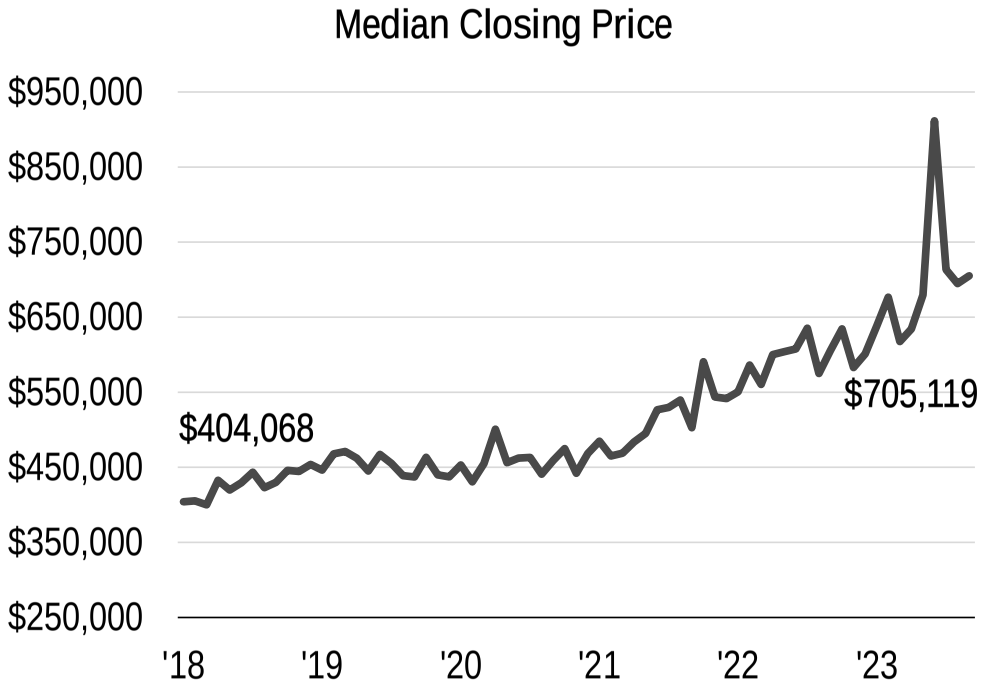


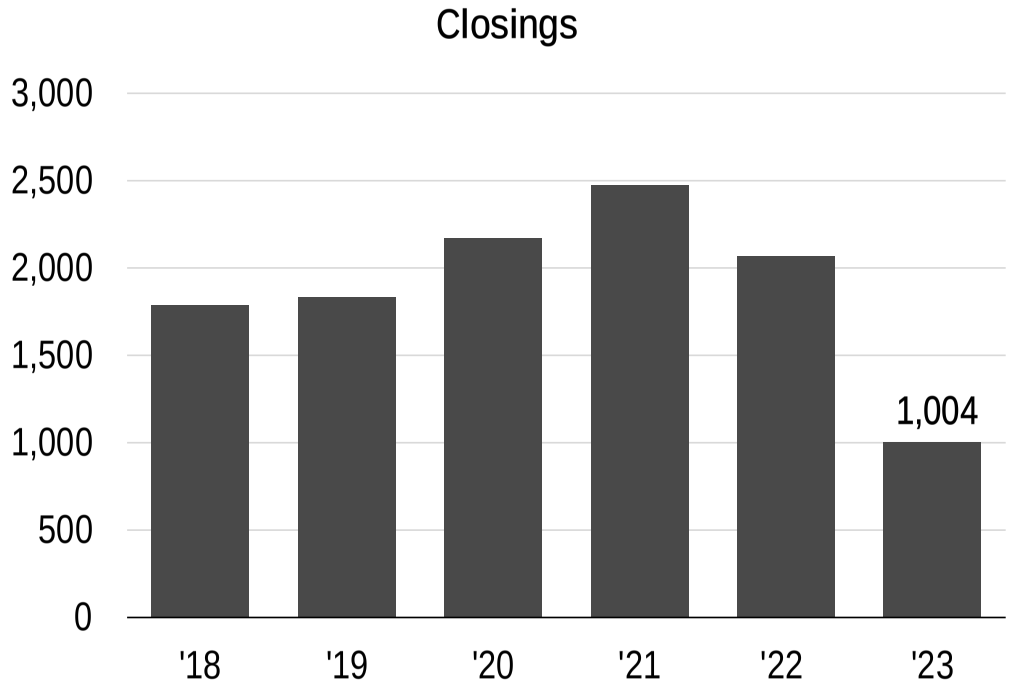
Source: Applied Analysis

New Homes

Northern Nevada

New home prices have fluctuated over the years but have showed a general increasing trend as new home sales have decreased every year since 2021.



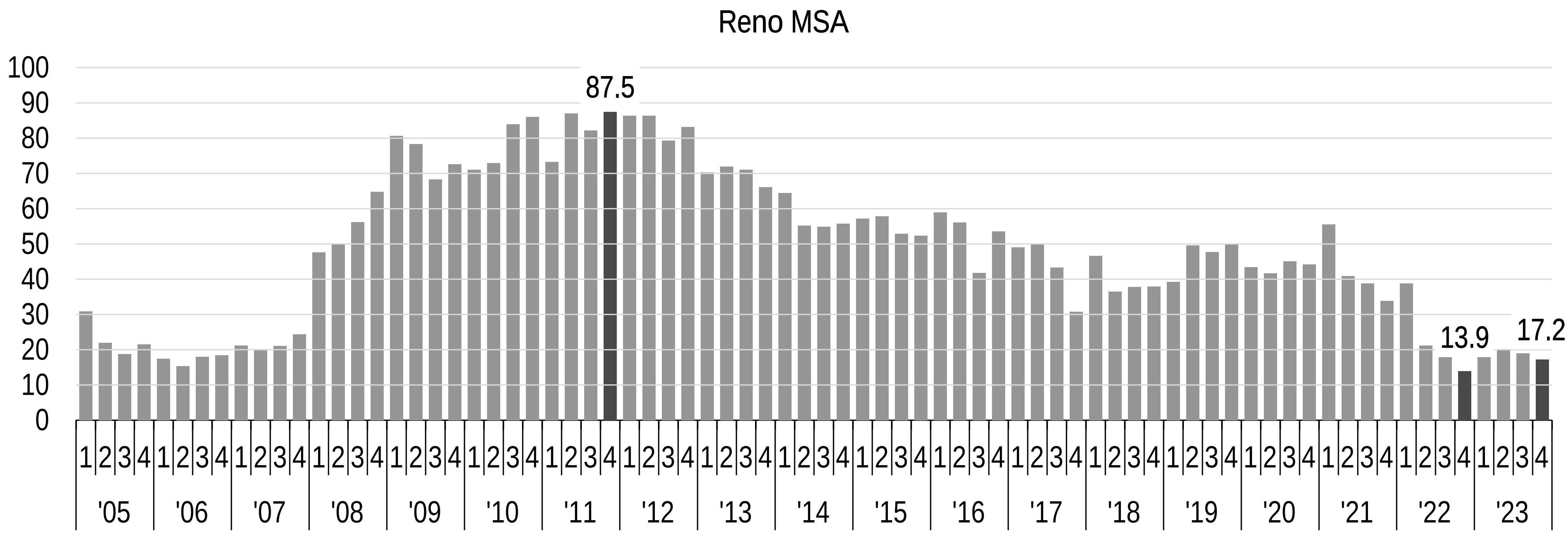


Source: Applied Analysis

Housing Opportunity Index

Northern Nevada

The housing opportunity index in Northern Nevada has climbed recently after reaching a low point in late 2022. Even with the recent improvement, just 17.2 percent of homes were considered affordable for a household with median income.

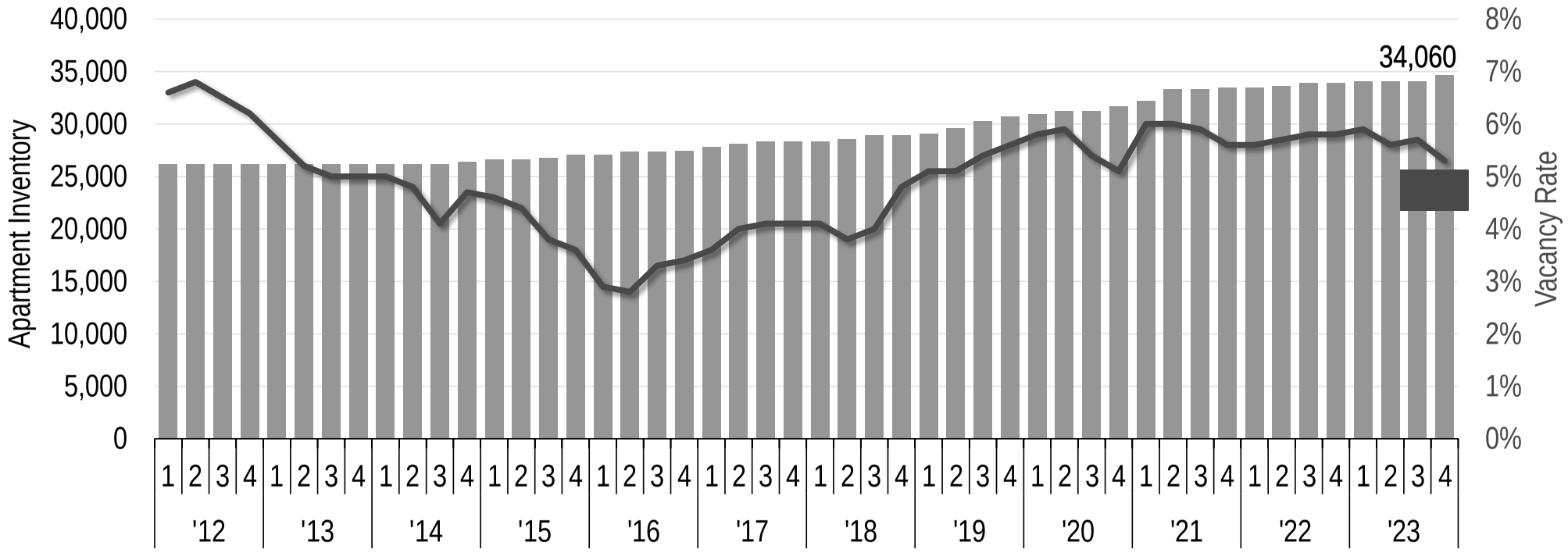


Source: National Association of Home Builders

Apartment Inventory & Vacancy Rate

Northern Nevada

Apartment inventory has experienced a slightly increasing trend in Northern Nevada. The increase in units pushed the regional vacancy rate over 5 percent, where it has remained over for the better part of the past five years.

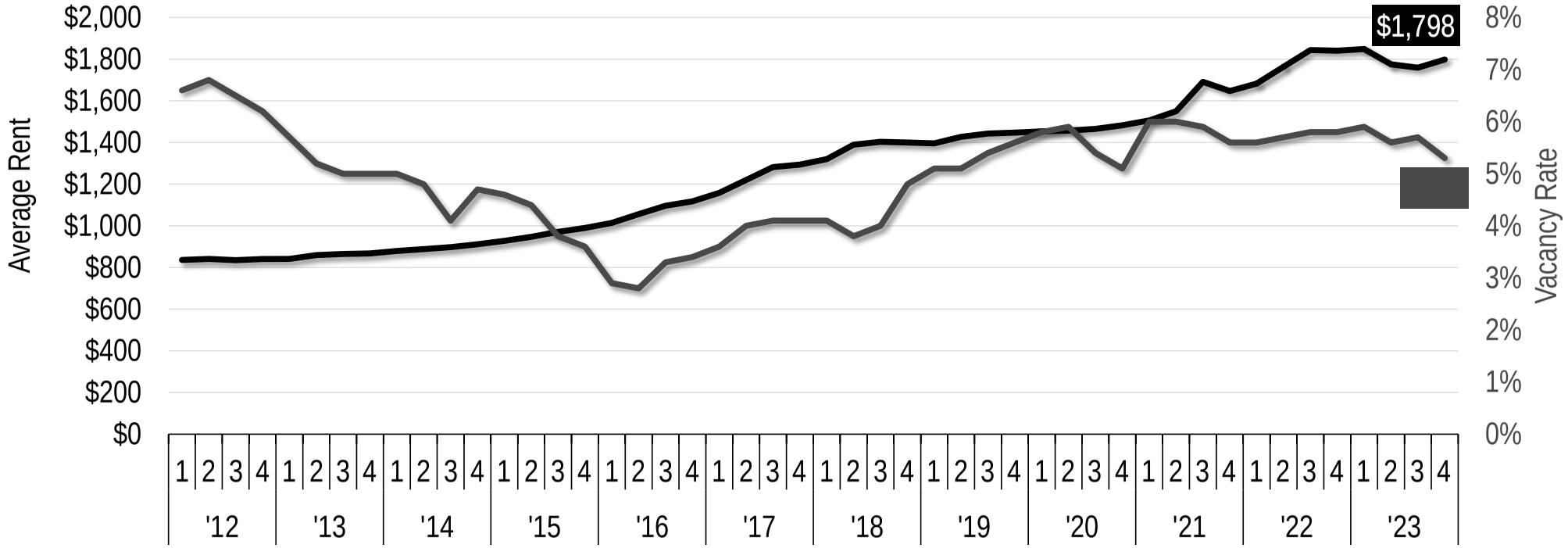


Source: REIS

Average Rent & Vacancy Rate

Northern Nevada

Average apartment rents in Northern Nevada have steadily climbed over the past decade. Regional rents experienced a moderate increase following the pandemic and has since stabilized as vacancy rates leveled off.

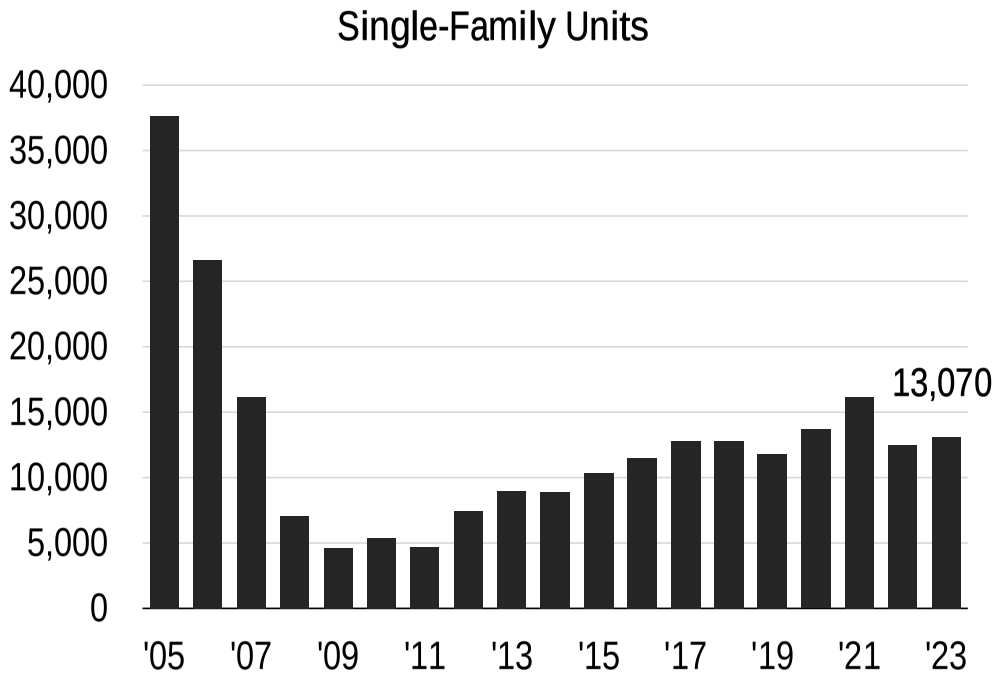


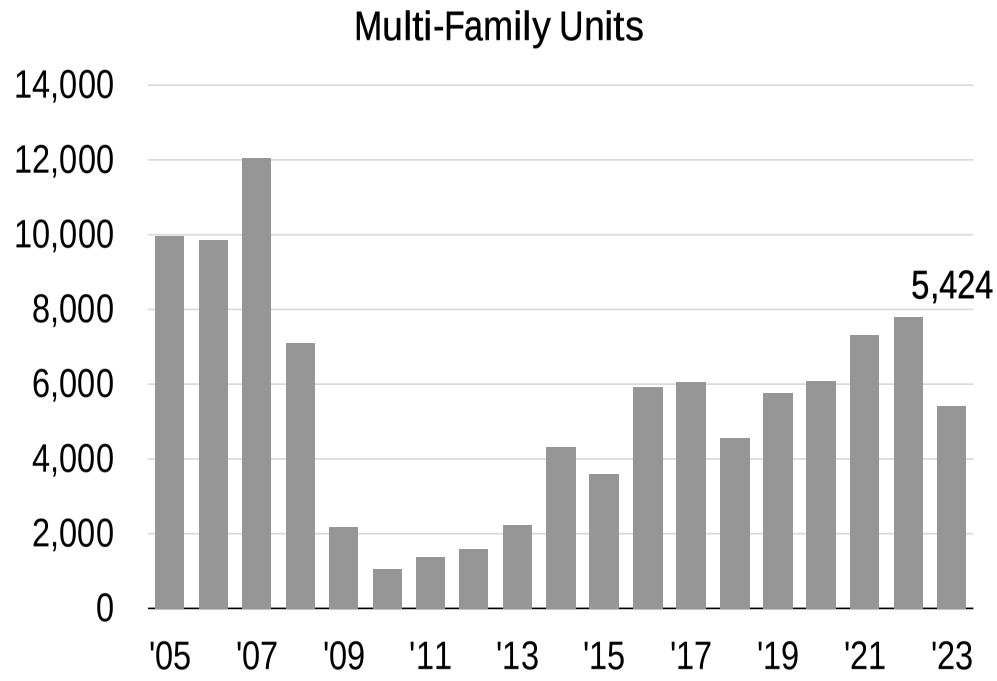
Source: REIS

Housing Permits

Nevada

Outside of the pandemic-related spike in demand and pricing, single family homebuilding has hovered between 12,000 and 14,000 units per year since 2017. Multi-family units, including apartments, have been on a generally rising trend.



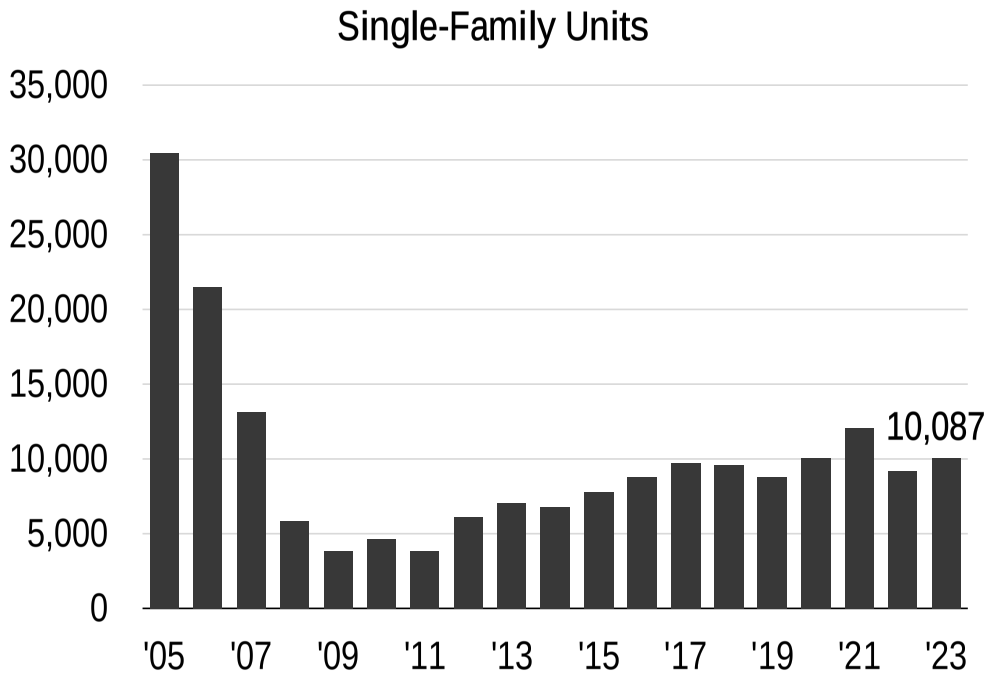


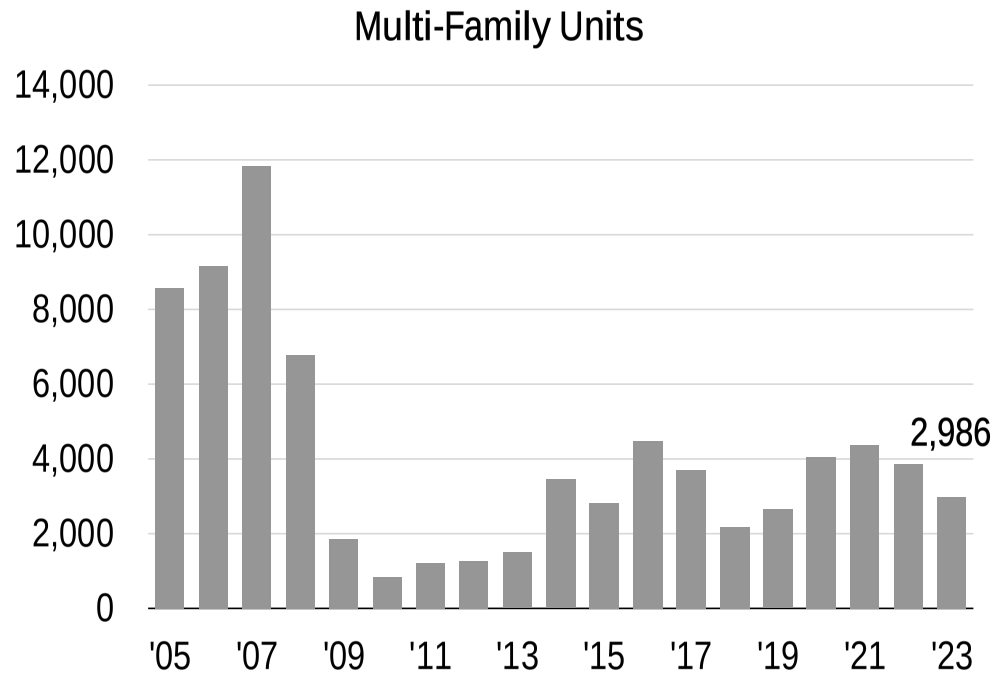
Source: U.S. Census Bureau

New Housing Permits

Southern Nevada

The statewide homebuilding trends have been driven by Southern Nevada, which accounts for the majority of single family home construction.



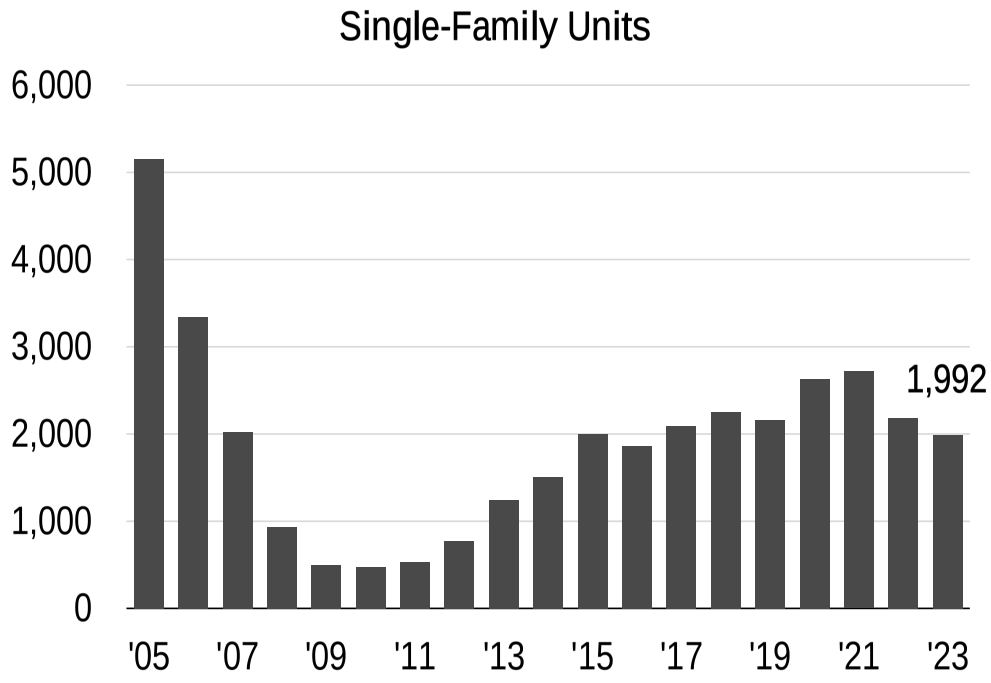


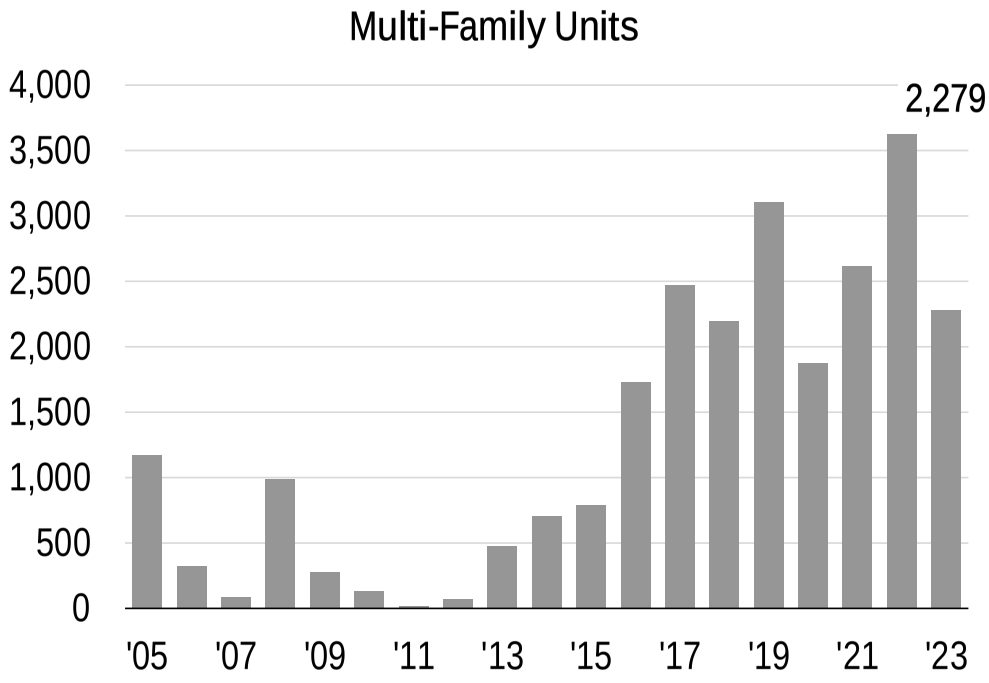
Source: U.S. Census Bureau

New Housing Permits

Northern Nevada

Homebuilding in Northern Nevada has hovered near 2,000 units for most of the past decade. By contrast, construction of multi-family units has accelerated in recent years.



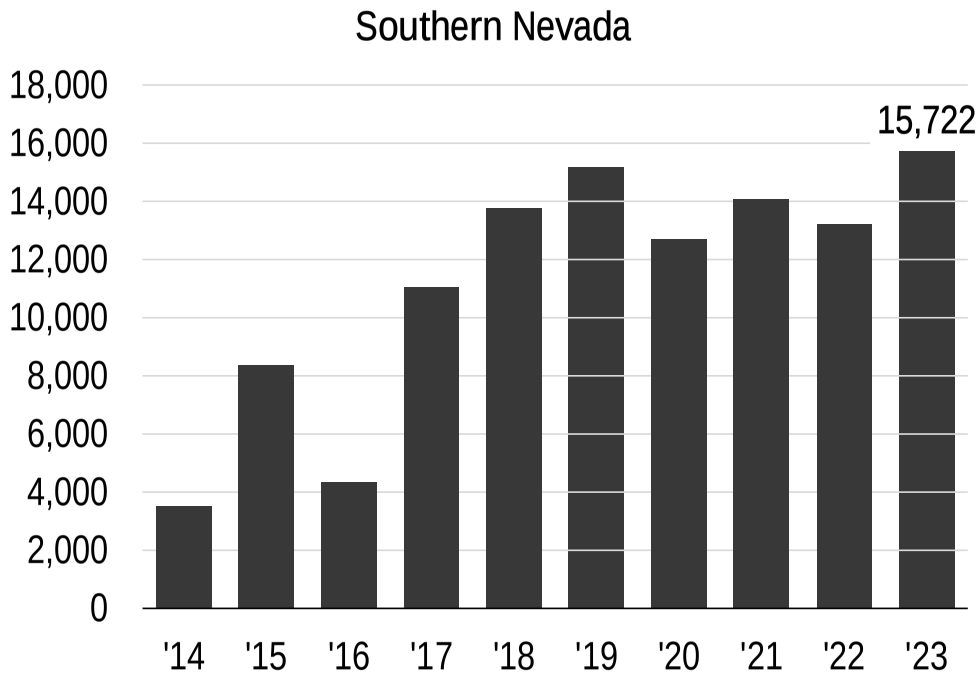


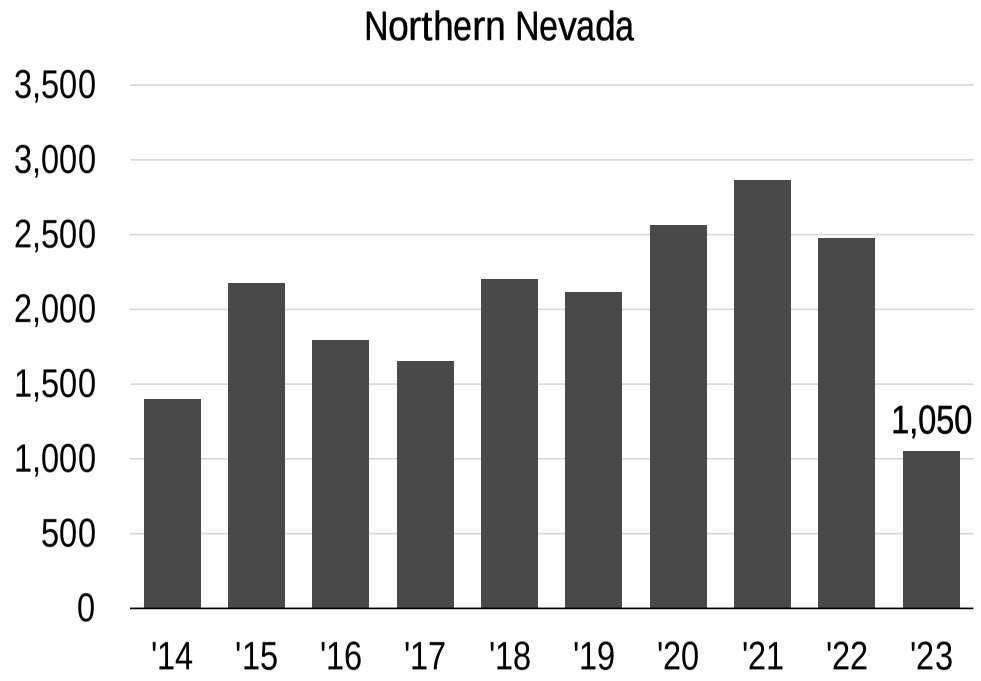
Source: U.S. Census Bureau

Total Housing Units Growth

In Nevada

Since 2013, Clark County has added more than 110,000 housing units. In Northern Nevada, the inventory of housing units increased by more than 20,000 over the decade.



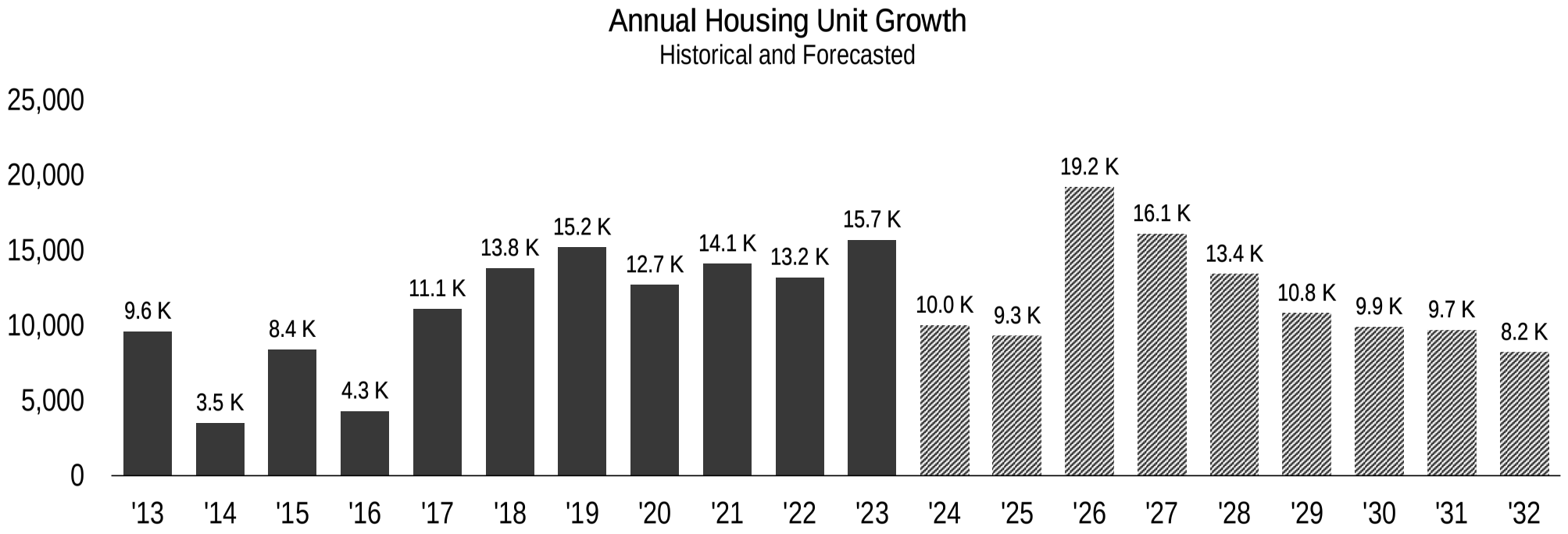


Source: Clark County Comprehensive Planning Department and SalesTraq

Housing Units Growth

Southern Nevada

Southern Nevada is projected to add more than 100,000 housing units by 2032, a growth rate of 11.7 percent. If the projection holds, the region would surpass 1 million housing units.



Source: Clark County Comprehensive Planning Department, U.S. Census Bureau, UNLV CBER, Applied Analysis

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

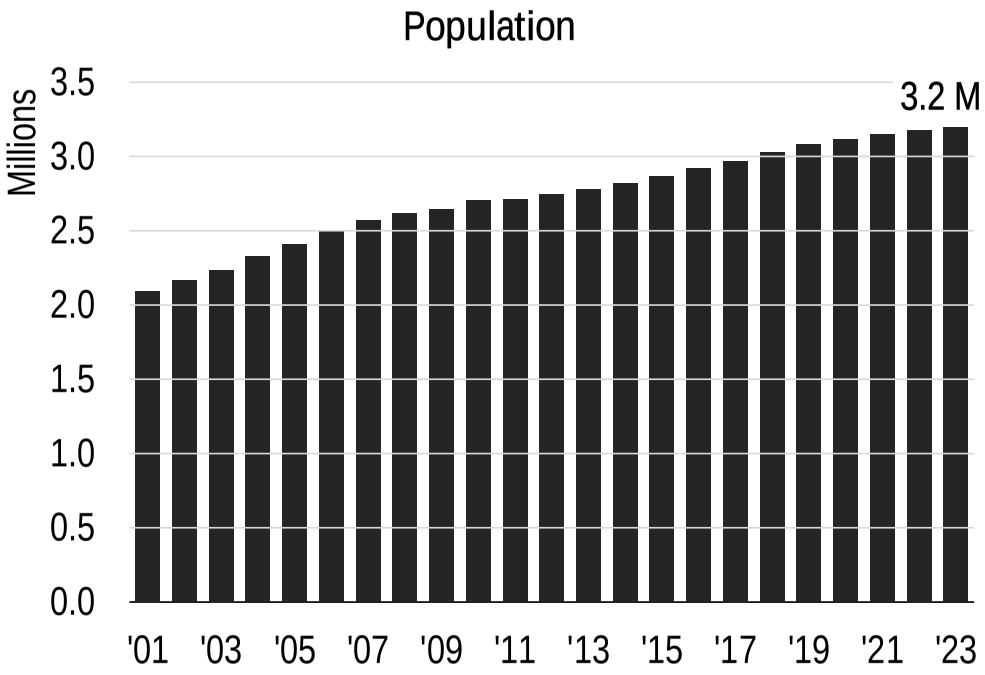
POPULATION AND MIGRATION

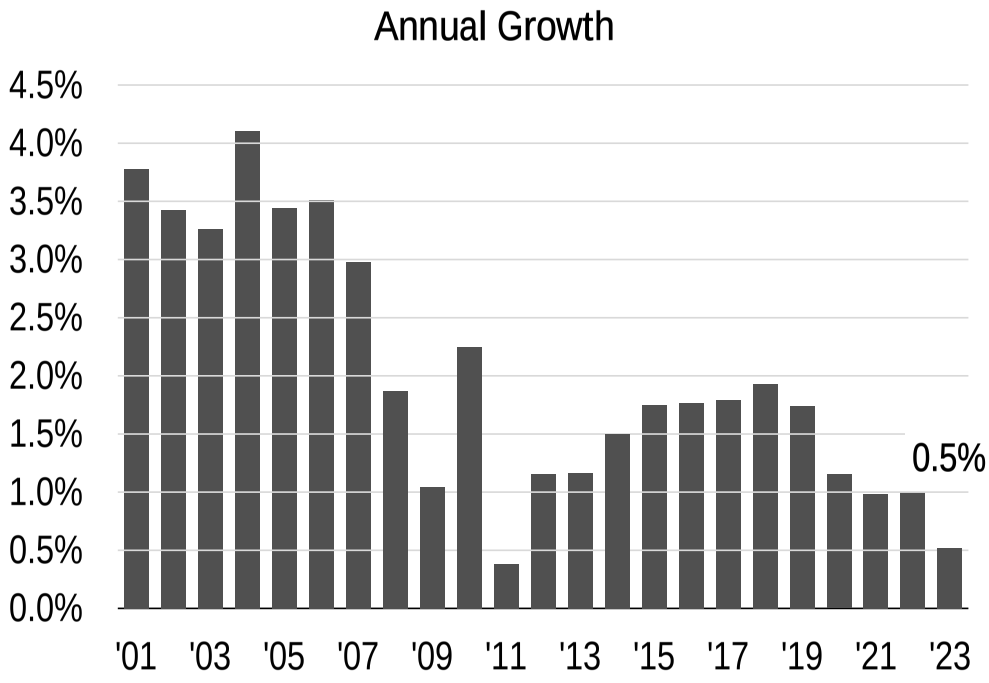
DEVELOPMENT PIPELINE

Population

Nevada

State population has steadily grown over the past two decades, reaching an all-time high of 3.2 million in 2023. Nevada has been one of the fastest growing during that period, though economic disruptions have curtailed growth at times.

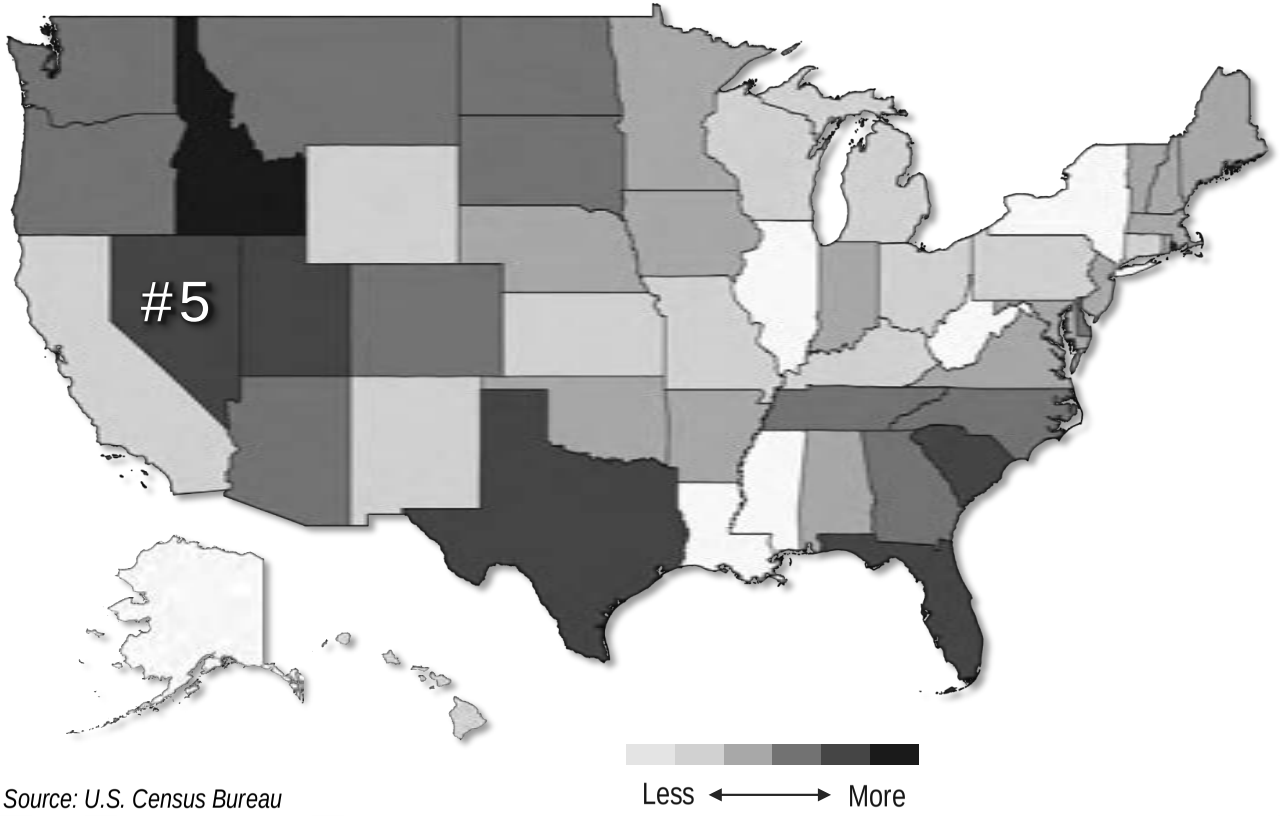




Source: U.S. Census Bureau

Population Growth by State

2013 vs. 2023

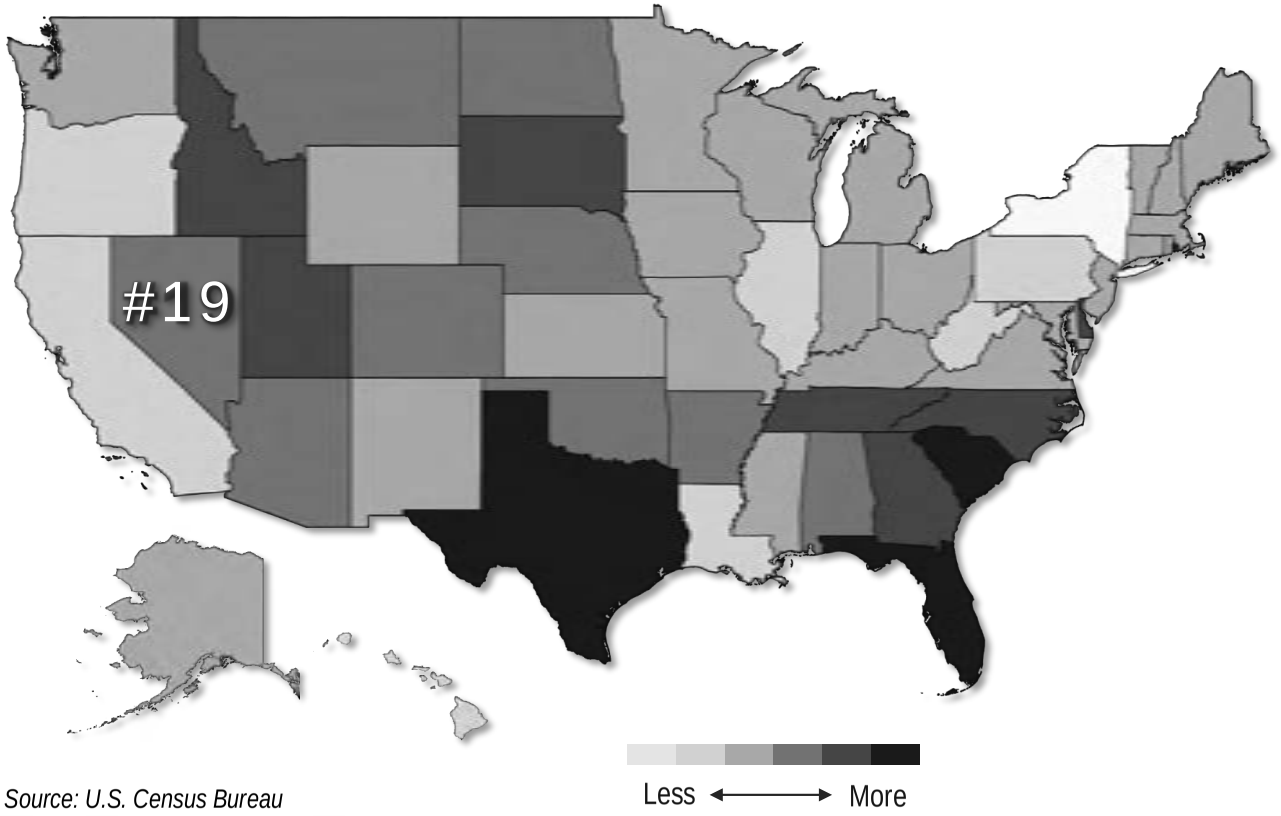


RANK	STATE	GROWTH
1	Idaho	20.5%
2	Utah	16.4%
3	Florida	13.9%
4	Texas	13.4%
5	NEVADA	13.1%
6	South Carolina	11.4%
7	Washington	10.9%
8	Arizona	10.7%
9	Montana	10.7%
10	Delaware	10.4%
U.S. AVERAGE		5.9%

Source: U.S. Census Bureau

Population Growth by State

2022 vs. 2023



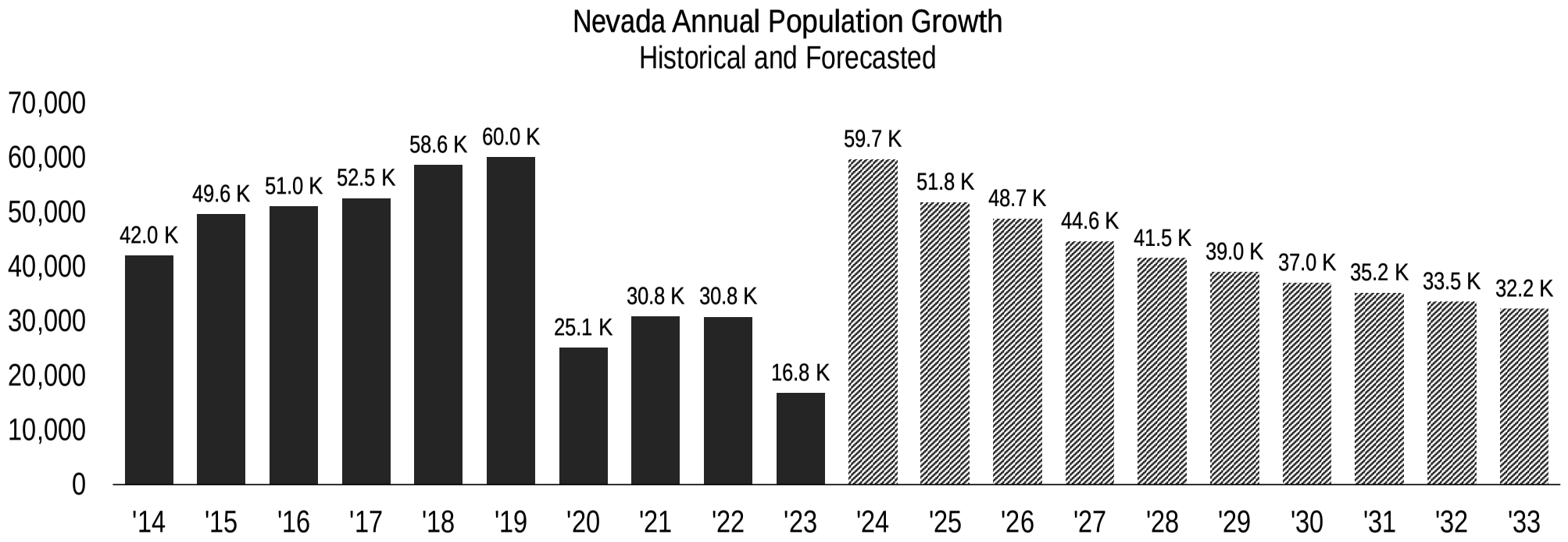
RANK	STATE	GROWTH
1	South Carolina	1.7%
2	Florida	1.6%
3	Texas	1.6%
4	Idaho	1.3%
5	North Carolina	1.3%
6	Delaware	1.2%
7	District of Columbia	1.2%
8	Tennessee	1.1%
9	Utah	1.1%
10	Georgia	1.1%
19	NEVADA	0.5%
	U.S. AVERAGE	0.5%

Source: U.S. Census Bureau

Population Growth

Historical and Forecast Growth

Nevada's population is projected to grow to 3.6 million by 2033 with the addition of more than 400,000 new residents.

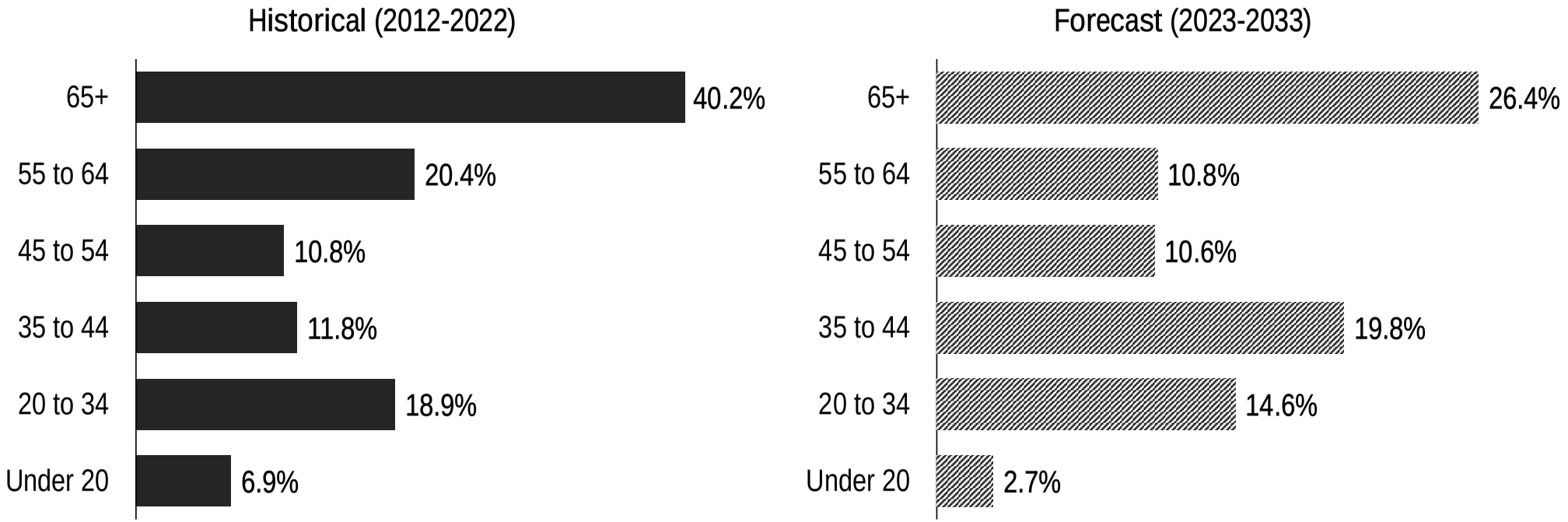


Source: U.S. Census Bureau, Nevada State Demographer, Applied Analysis

Population Growth Projections

Nevada | By Age

The aging Baby Boomer generation made the 65-and-up age group the fastest-growing over the past decade. In the coming decade, population growth is projected to be more evenly distributed across age groups.

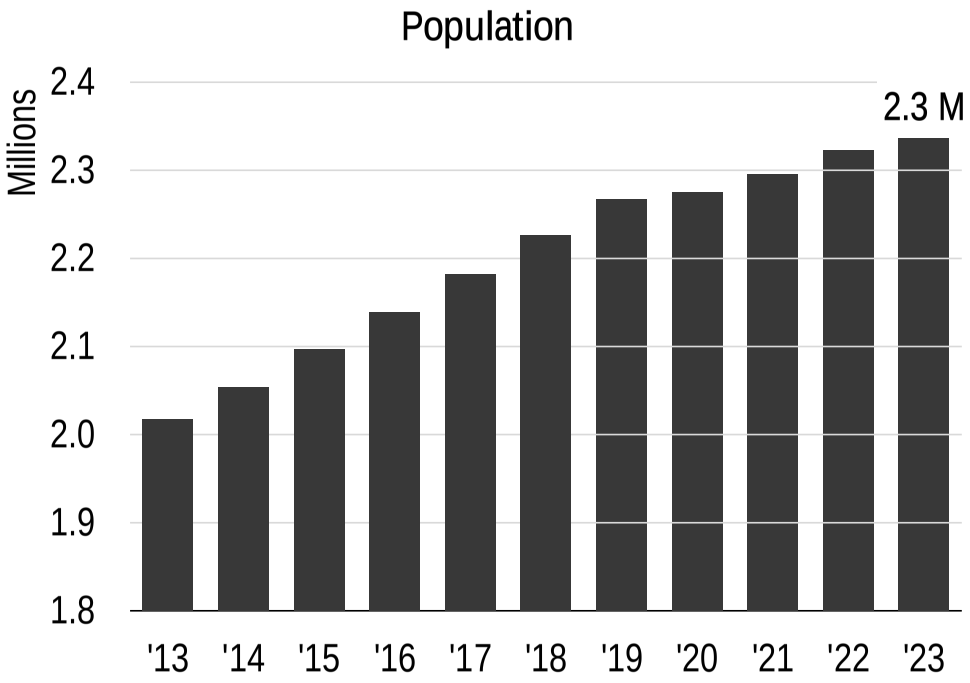


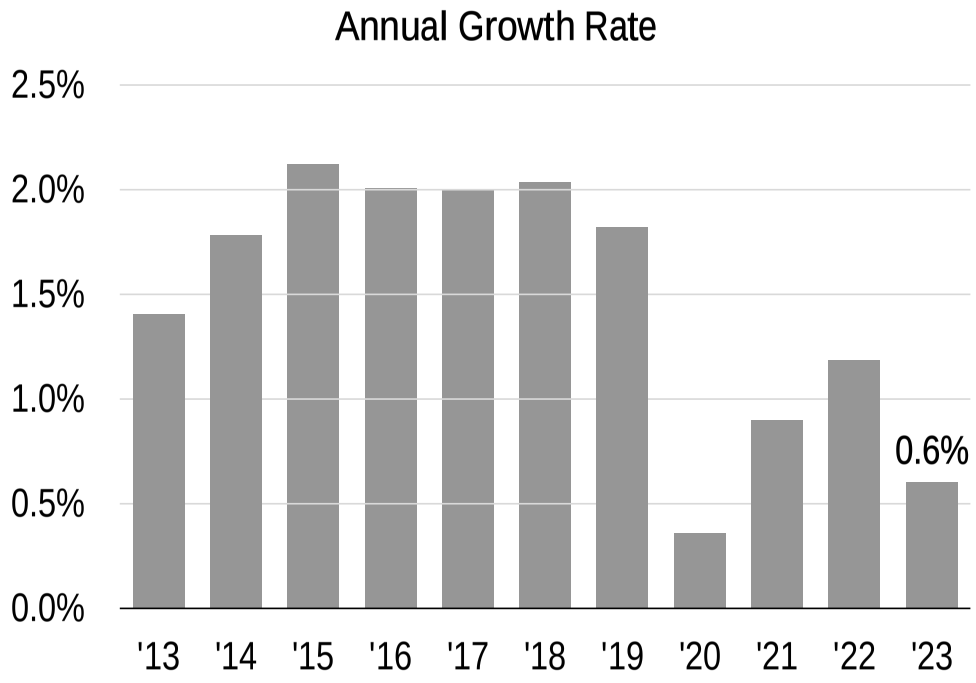
Source: Nevada State Demographer

Population

Southern Nevada

Population has continued to steadily increase over the past decade in Southern Nevada with the addition of more than 300,000 residents. Annual growth slowed significantly during the pandemic and has yet to rebound to earlier levels.



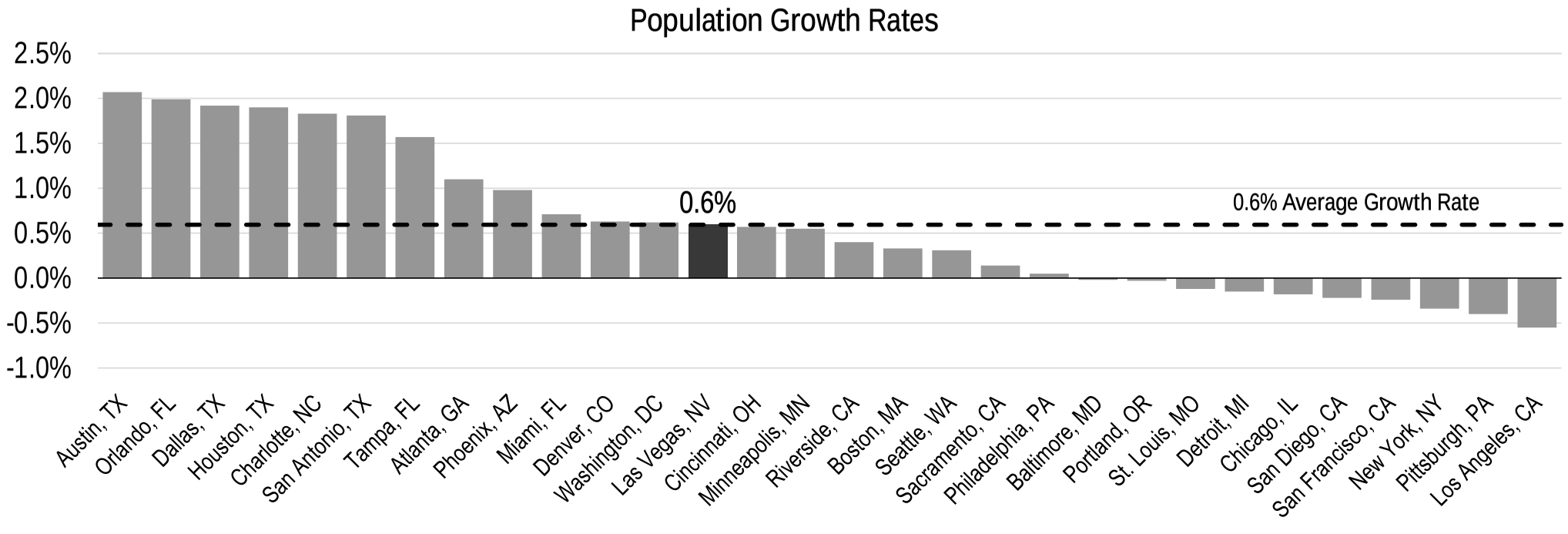


Source: U.S. Census Bureau

Population Growth

30 Largest Metro Areas | 2022 to 2023

Southern Nevada ranked 13th in annual population growth rate among the 30 largest metropolitan areas, its lowest rank in a non-pandemic year since 2011.

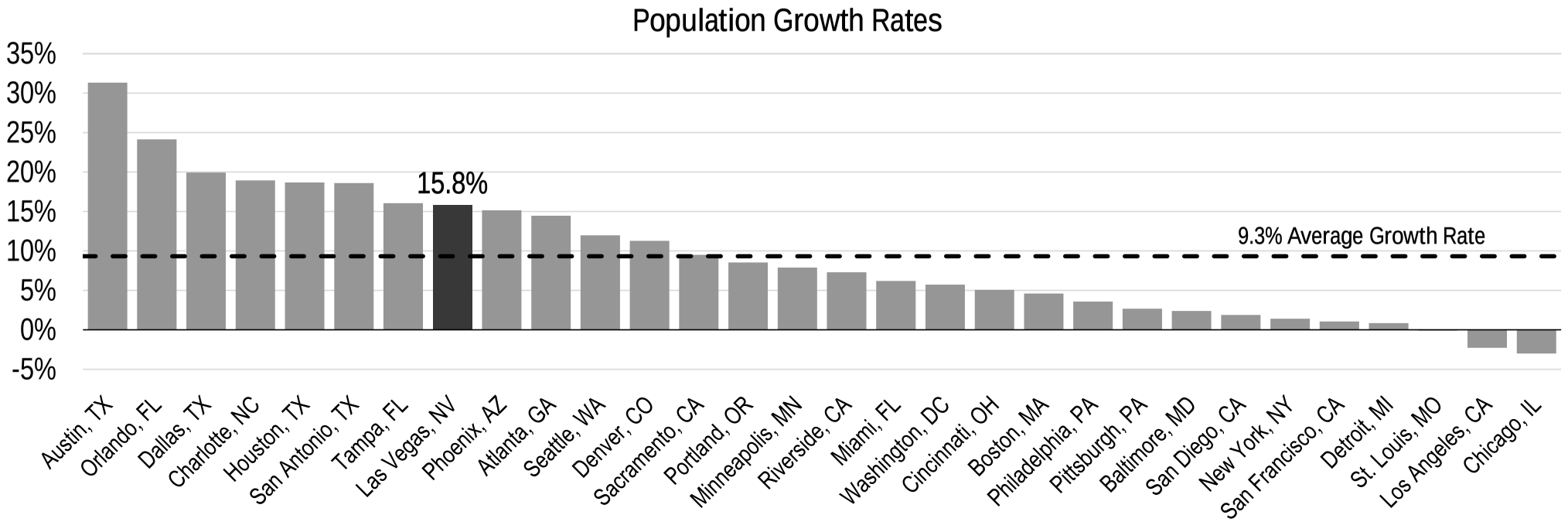


Source: U.S. Census Bureau

Population Growth

30 Largest Metro Areas | 2013 to 2023

Southern Nevada ranked eighth in population growth rate since 2013 among the 30 largest metropolitan areas. Over that time, the region has ranked as high as third (2018 and 2019) and as low as 20th (2020).

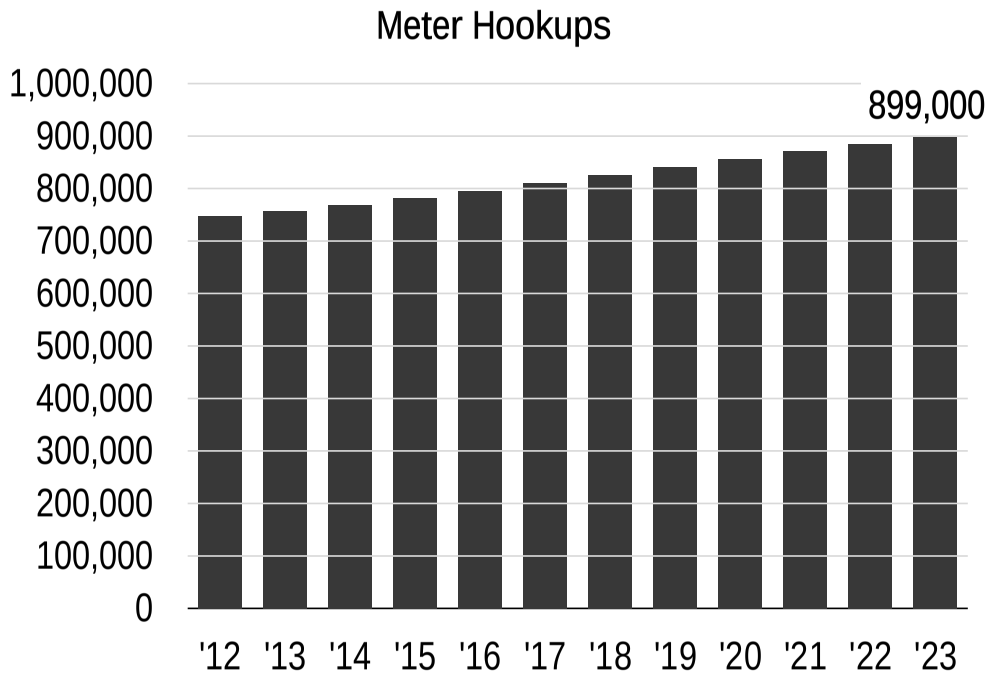


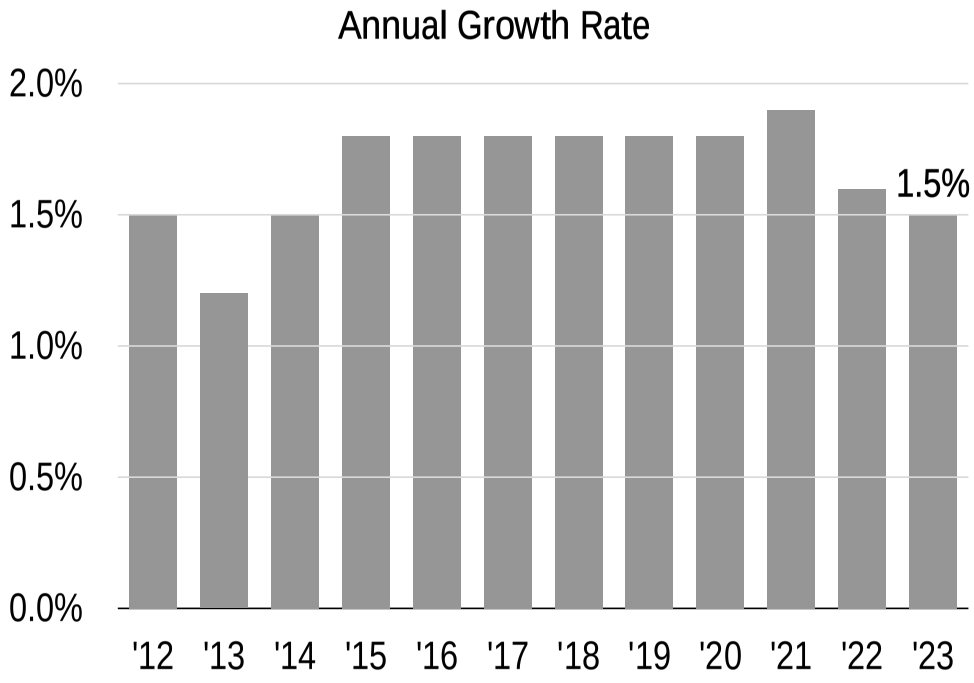
Source: U.S. Census Bureau

Electric Meter Hookups Growth

Southern Nevada

Electric meter hookups in Southern Nevada are consistently increasing and ranged from 1.4 percent and 2.0 percent in annual growth since 2018.



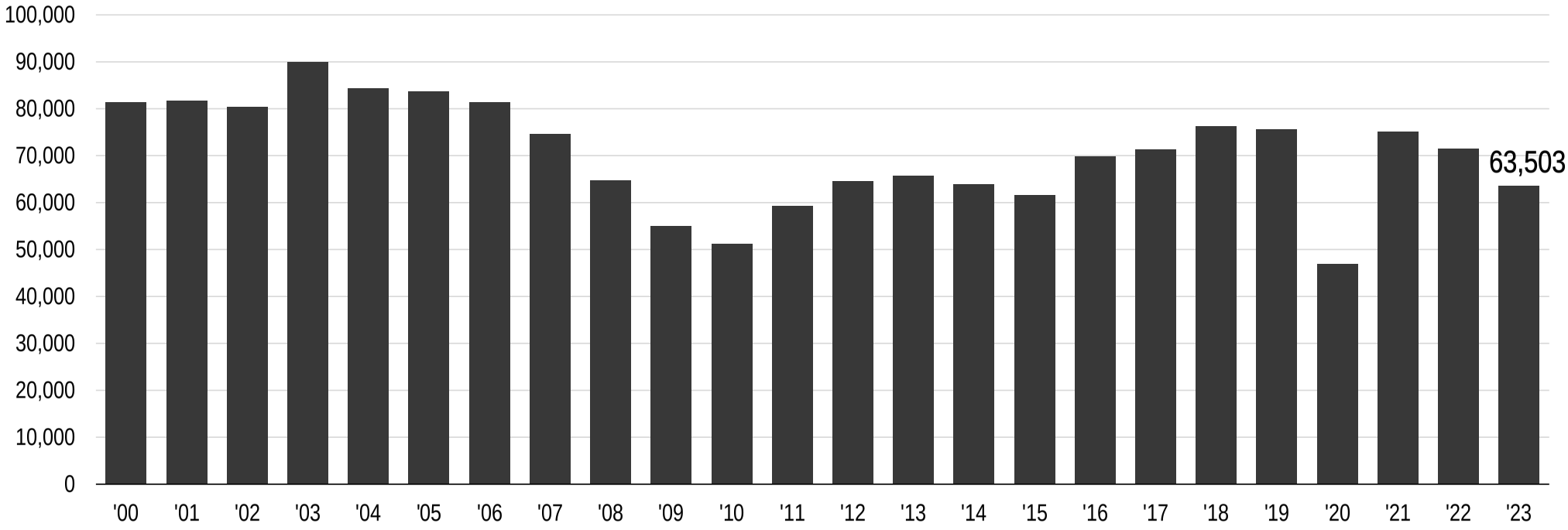


Source: NV Energy

Driver's License Surrenders

To Clark County

The number of drivers surrendering their licenses in Clark County rebounded to 75,000 once DMV offices reopened following the pandemic-related closures of 2020, but surrenders have since fallen to the lowest annual total since 2015 (excluding 2020).

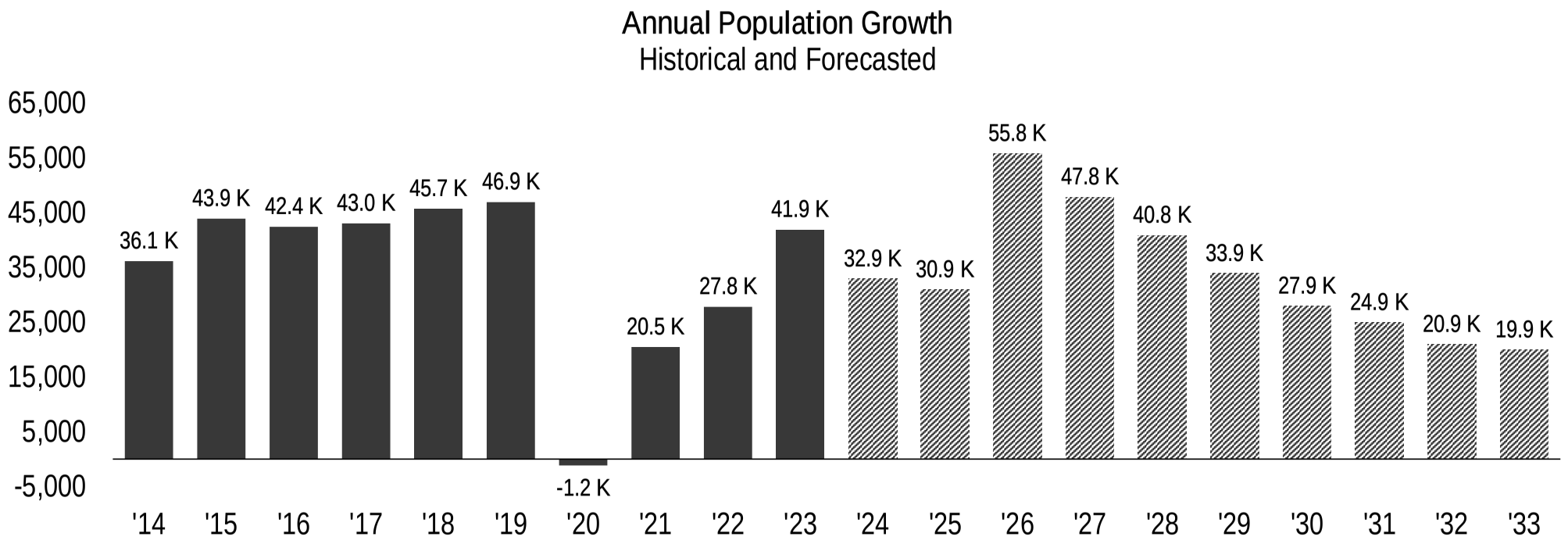


Source: Nevada Department of Motor Vehicles. Note: Data presented shows trailing-twelve-month totals.

Population Growth

Southern Nevada

Clark County is projected to grow to 2.7 million by 2032 with the addition of more than 350,000 residents.

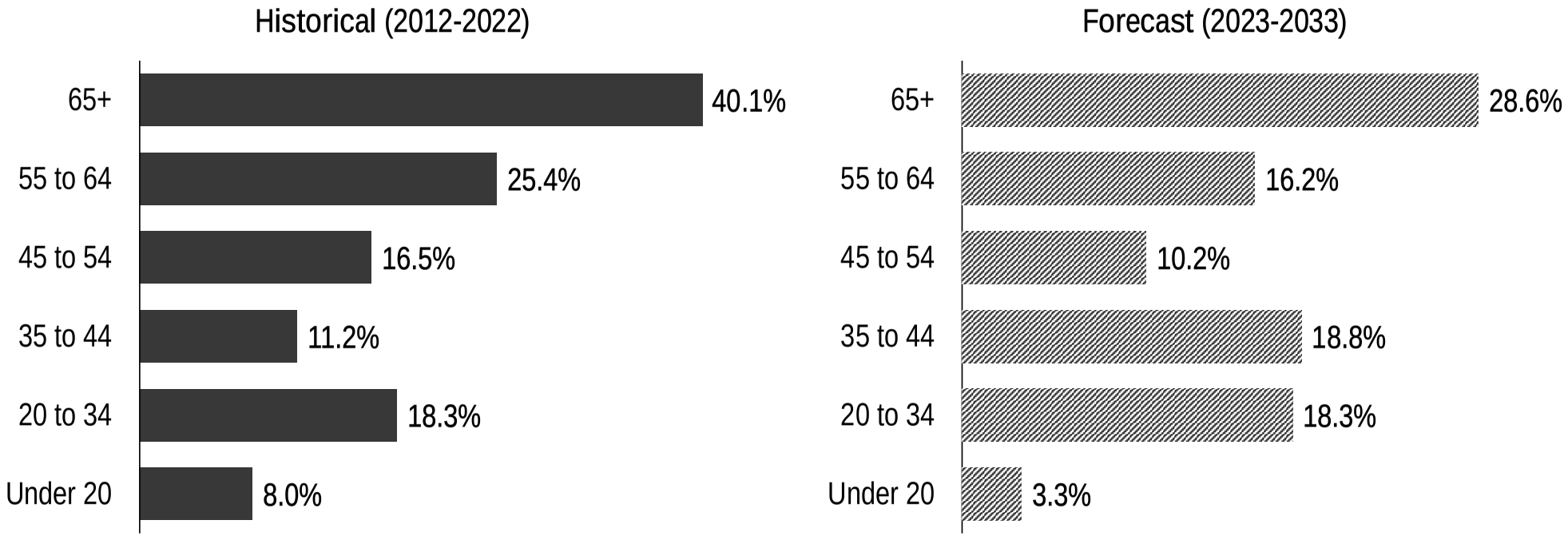


Source: U.S. Census Bureau, Center for Business and Economic Research at University of Nevada, Las Vegas, Applied Analysis

Population Growth Projections

Southern Nevada | By Age

Population growth was concentrated in older age groups over the past decade. Looking forward, population growth is projected to be more evenly distributed across cohorts.

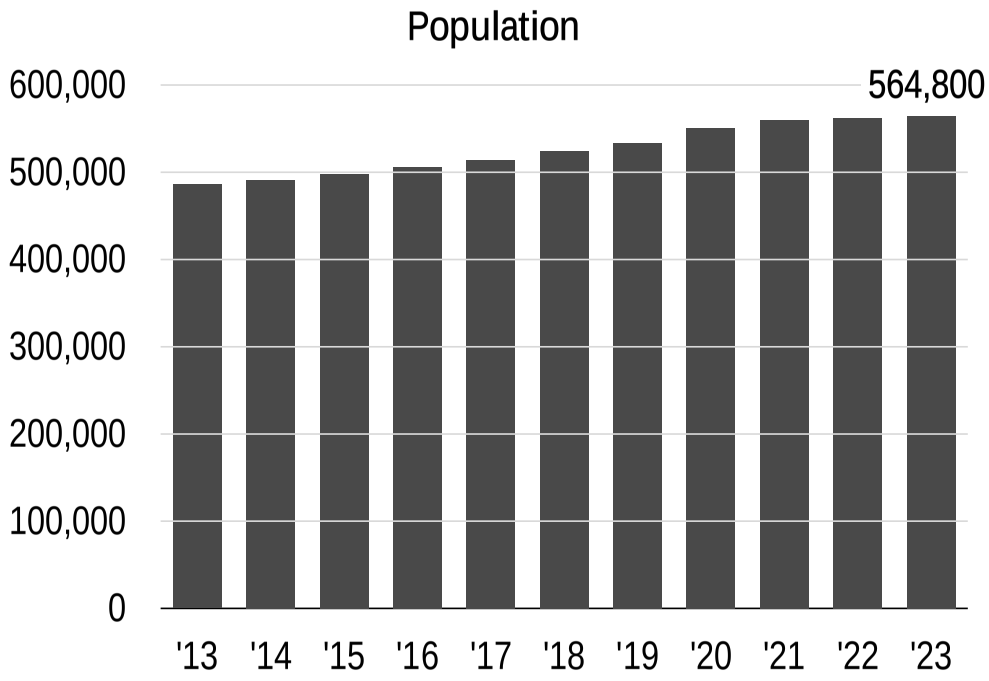


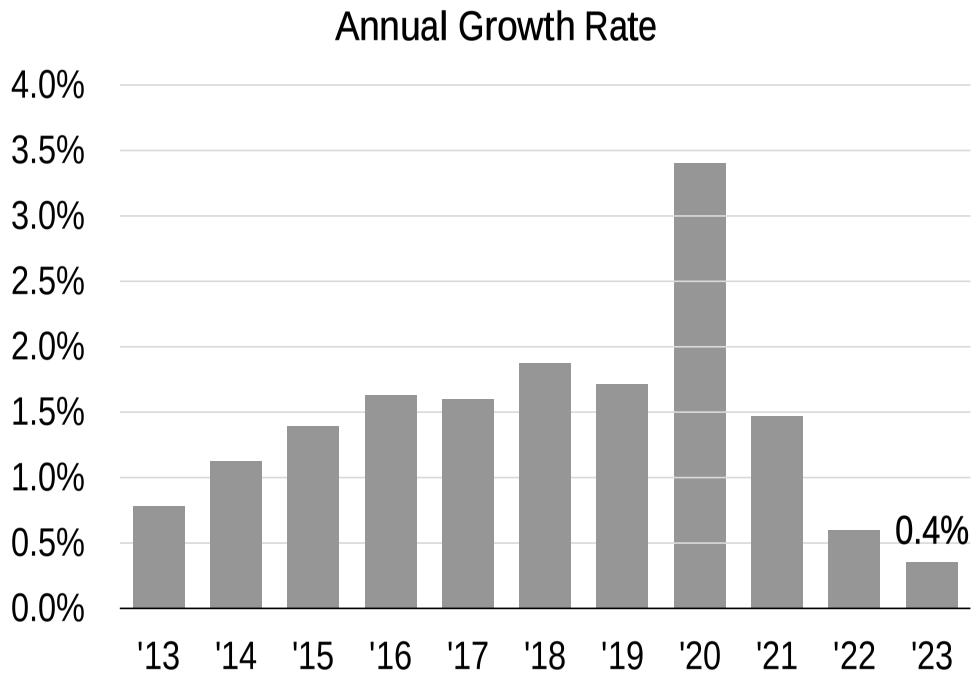
Source: Nevada State Demographer

Population

Northern Nevada

Population in the region spiked in 2020, when it grew as much as it did in the prior two years combined. Newcomers from California and other states relocated to Northern Nevada as remote work expanded amid the pandemic.



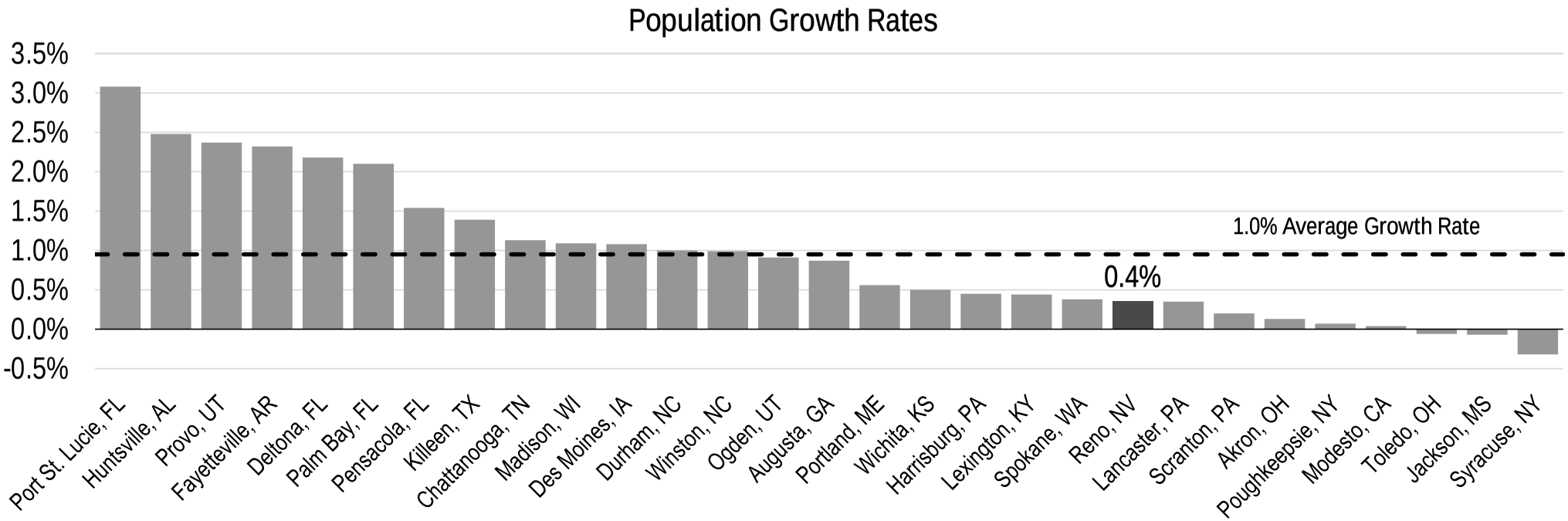


Source: U.S. Census Bureau

Population Growth

Mid-Sized Metro Areas | 2022 to 2023

After ranking fifth in population growth among comparable metropolitan areas in 2020, Northern Nevada has slipped in the rankings. In the latest year, the region fell into the bottom half of the population growth ranking among its peers.

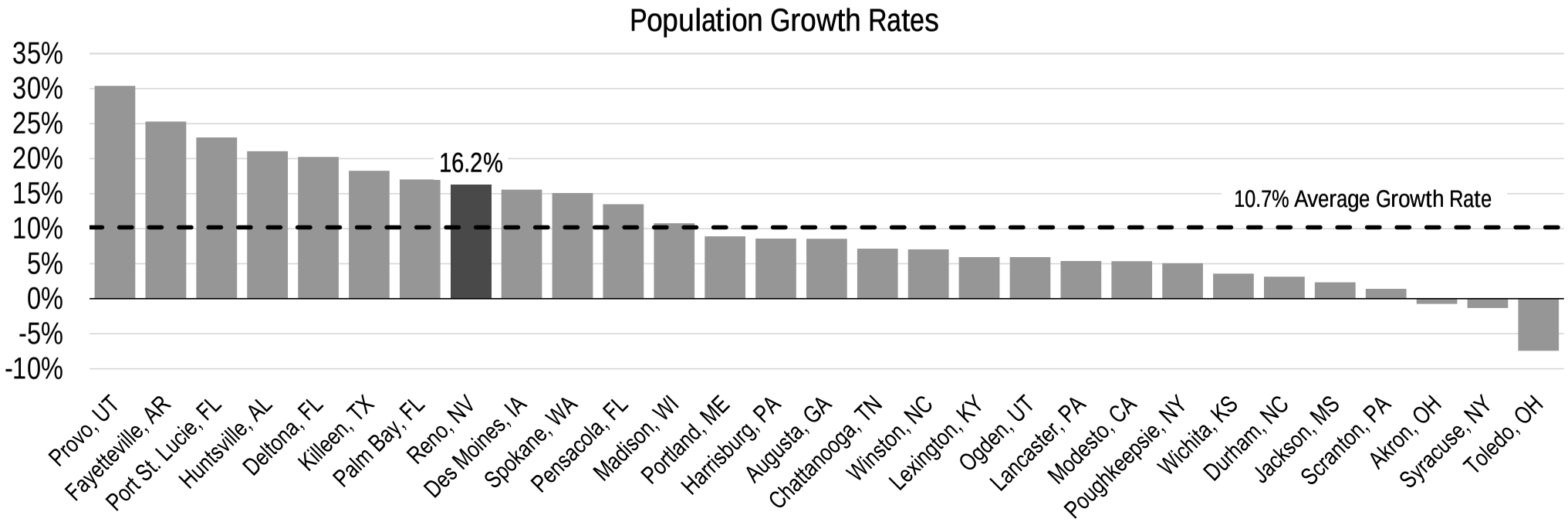


Source: U.S. Census Bureau. Note: Mid-sized metropolitan areas with populations between 500,000 and 750,000.

Population Growth

Mid-Sized Metro Areas | 2013 to 2023

Northern Nevada had the eighth-fastest population growth rate over the past decade among peer metropolitan areas. The highest annual ranking during that time was third in 2018.

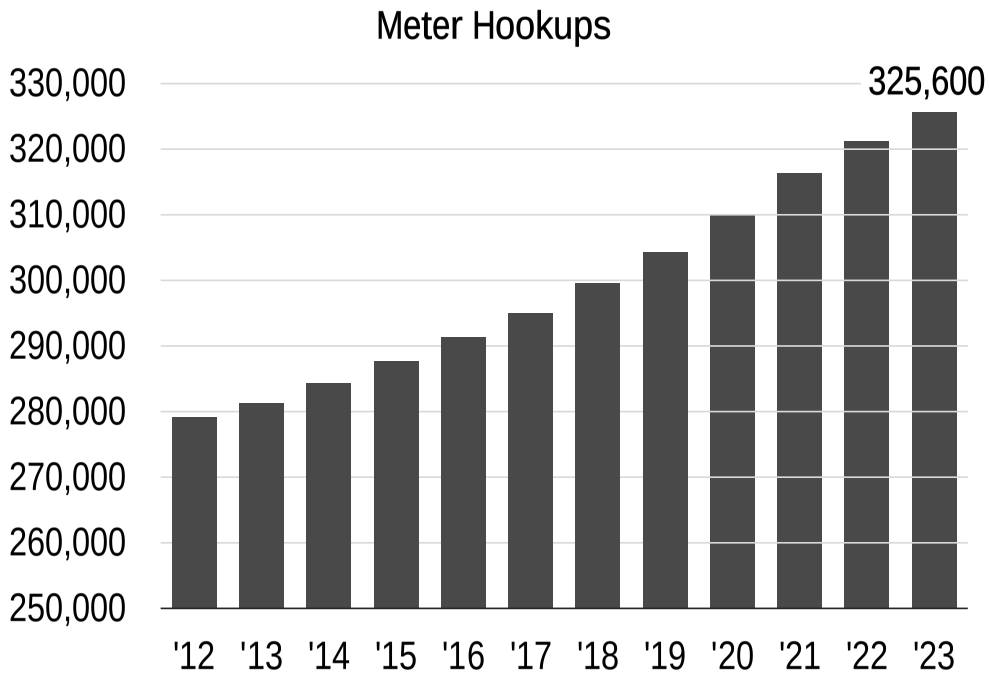


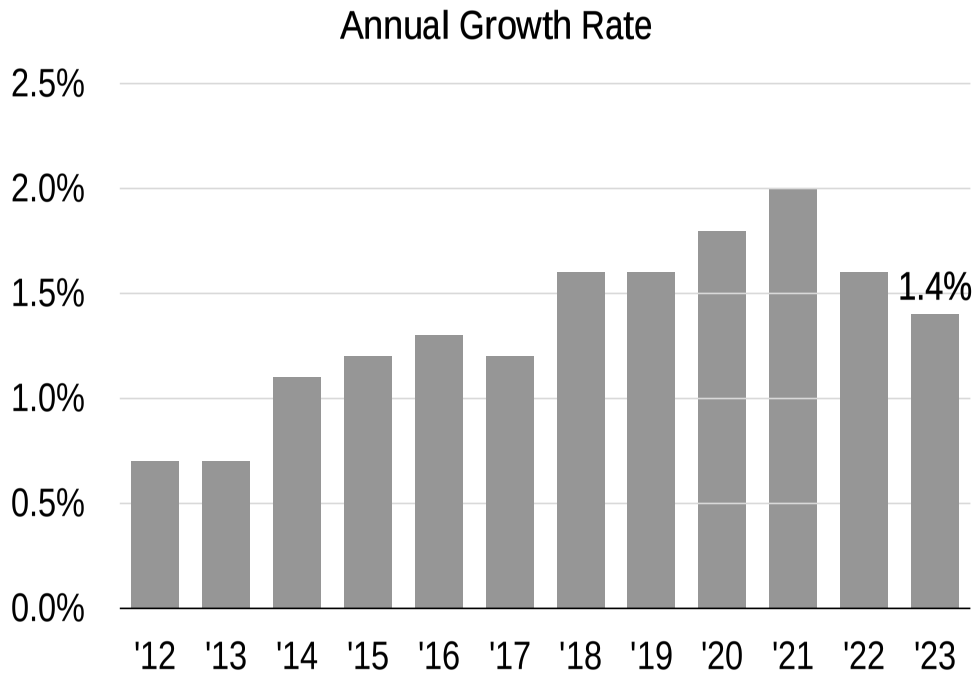
Source: U.S. Census Bureau. Note: Mid-sized metropolitan areas with populations between 500,000 and 750,000.

Electric Meter Hookups Growth

Northern Nevada

Electric meter hookups in Southern Nevada are consistently increasing and ranged from 1.4 percent and 2.0 percent in annual growth since 2018.



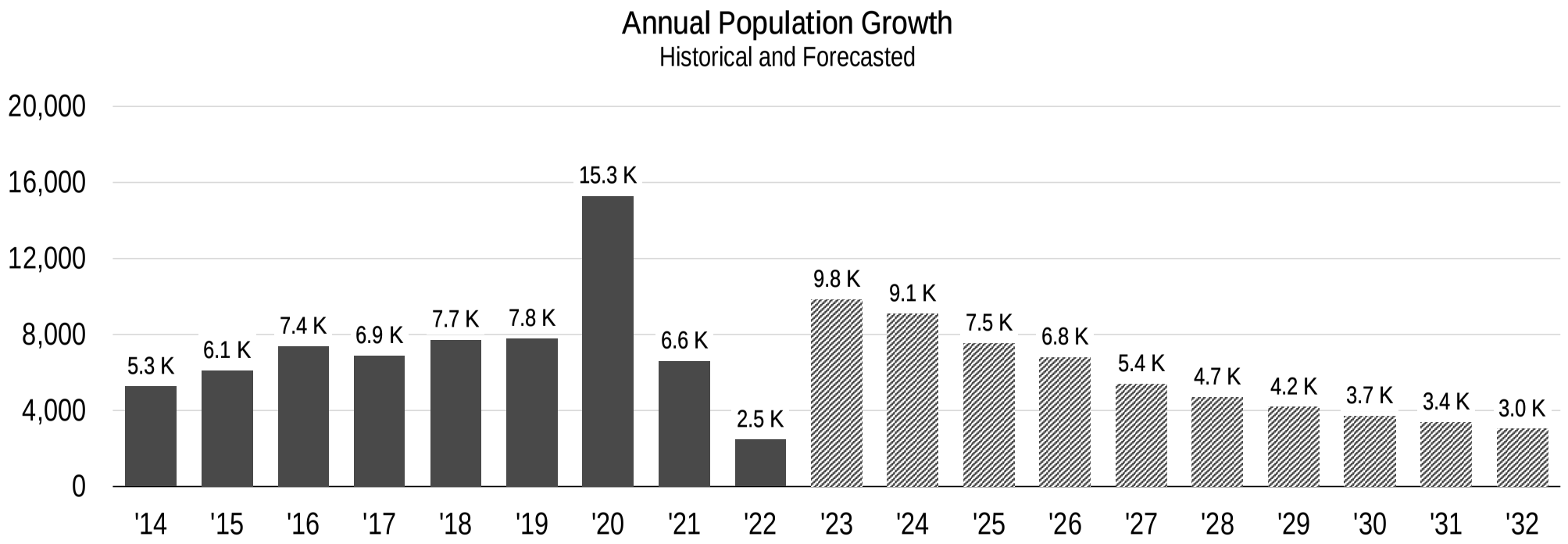


Source: NV Energy

Population Growth

Northern Nevada

Washoe County population is projected to surpass 550,000 by 2032 with the addition of more than 55,000 residents.

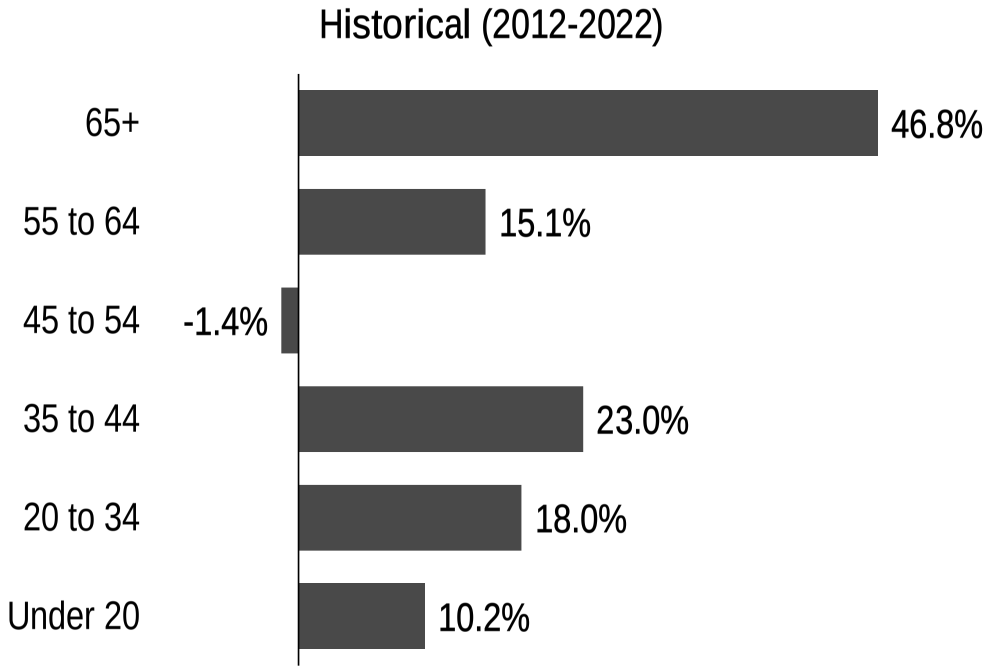


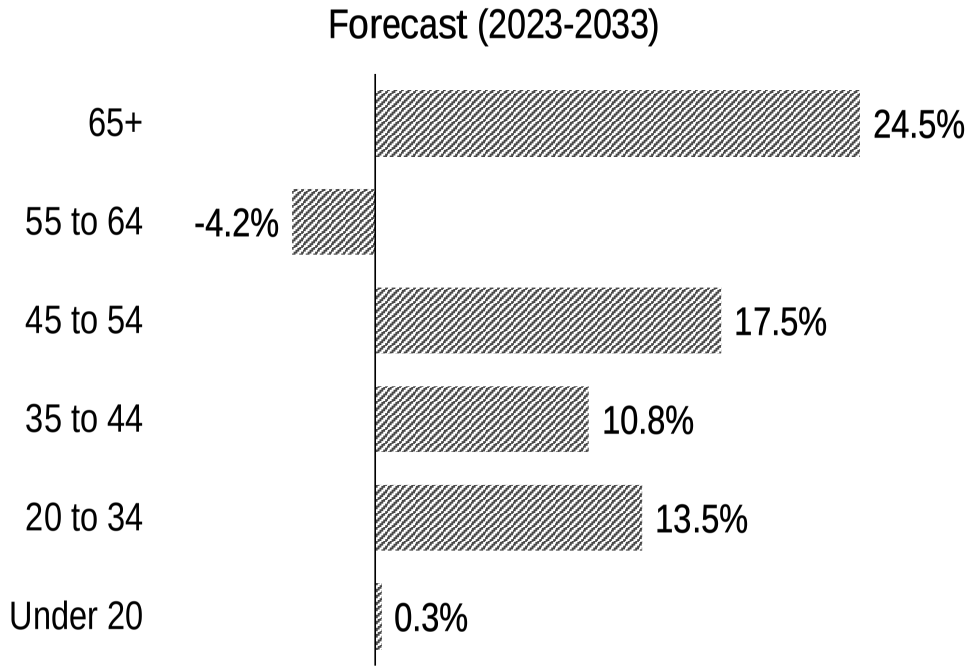
Source: U.S. Census Bureau, Nevada State Demographer, Applied Analysis

Population Growth Projections

Northern Nevada | By Age

Population growth in Northern Nevada was heavily concentrated in the oldest age group over the past decade. The over-65 age group is projected to lead population growth in the decade ahead, with a notable decline in the 55-to-64 age group.



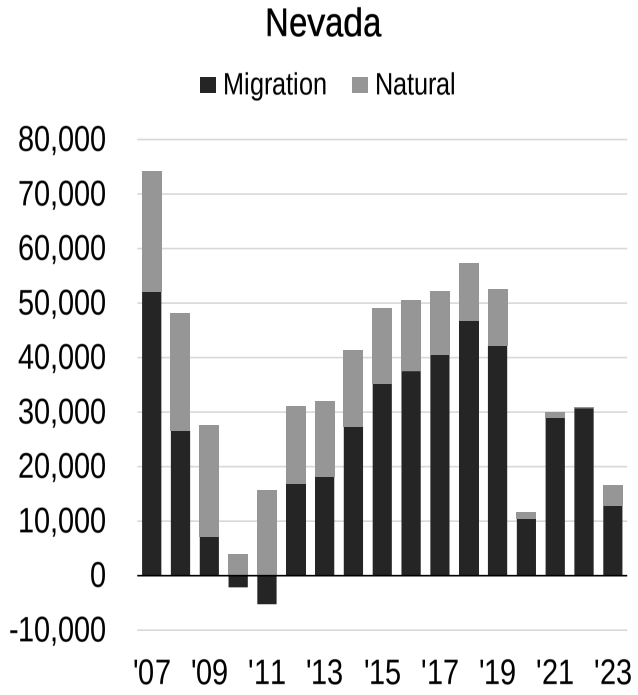


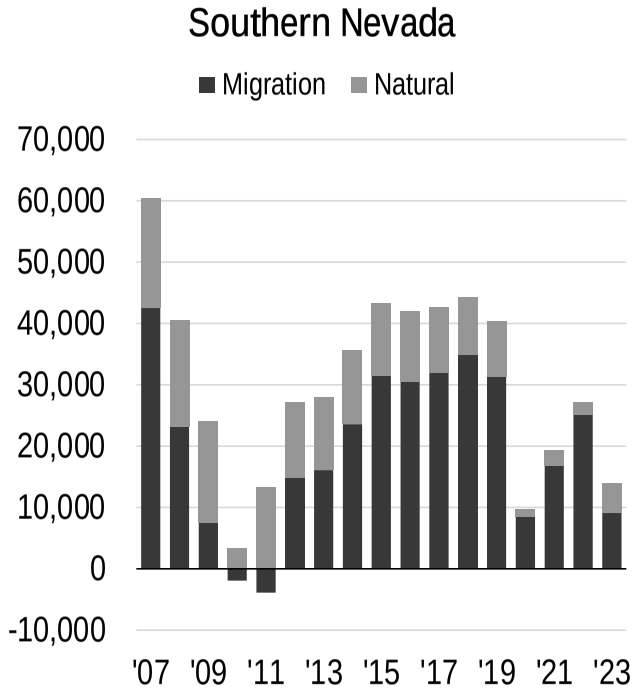
Source: Nevada State Demographer

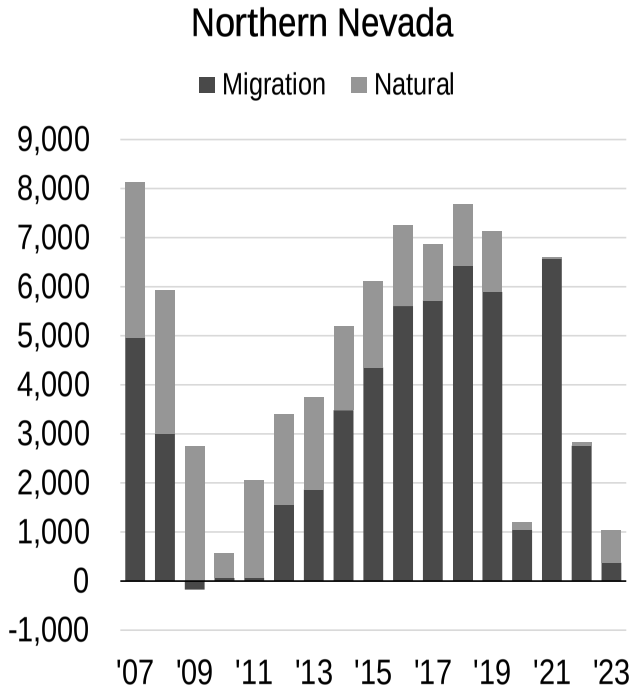
Migration Share of Population Growth

Nevada

New residents moving into Nevada have long been the primary source of population growth in the state. Over the past two decades, incoming residents have accounted for about three-quarters of the state's population growth.







Source: U.S. Census Bureau

Migration to Nevada

Top 10 Origins Since 2005

California has been the primary source of incoming residents to Nevada, accounting for a third of all new residents since 2005. No other state accounted for more than 5 percent of new residents.

Nevada		
Origin	Movers	% of Total
California	875,900	34.2%
Arizona	122,500	4.8%
Texas	99,300	3.9%
Utah	86,400	3.4%
Washington	84,200	3.3%
Florida	80,700	3.2%
Colorado	70,300	2.7%
Hawaii	67,400	2.6%
Illinois	58,400	2.3%
Mexico	55,200	2.2%

Southern Nevada		
Origin	Movers	% of Total
California	622,300	32.1%
Arizona	99,800	5.2%
Texas	75,800	3.9%
Florida	69,000	3.6%
Hawaii	61,400	3.2%
Utah	60,000	3.1%
Colorado	58,400	3.0%
Washington	54,100	2.8%
Illinois	51,400	2.7%
New York	46,900	2.4%

Northern Nevada		
Origin	Movers	% of Total
California	156,000	43.8%
Texas	15,200	4.3%
Washington	13,800	3.9%
Arizona	10,400	2.9%
Oregon	9,900	2.8%
Utah	9,200	2.6%
Florida	8,500	2.4%
Colorado	7,400	2.1%
Mexico	6,300	1.8%
Idaho	5,400	1.5%

Source: IPUMS USA, University of Minnesota; Applied Analysis

Top 10 Counties of Origin
2020 - 2021

Migration to Southern Nevada			
County	Households	Share	Income
Los Angeles County, CA	7,080	12.7%	$100,100
Orange County, CA	2,090	3.8%	$372,900
San Diego County, CA	2,040	3.6%	$106,500
San Bernardino County, CA	1,800	3.5%	$54,400
Riverside County, CA	1,450	2.7%	$70,300
Maricopa County, AZ	1,380	2.5%	$126,400
Honolulu County, HI	1,220	2.4%	$65,800
Washoe County, NV	930	1.5%	$120,500
Cook County, IL	890	1.5%	$88,800
Santa Clara County, CA	850	1.5%	$418,000

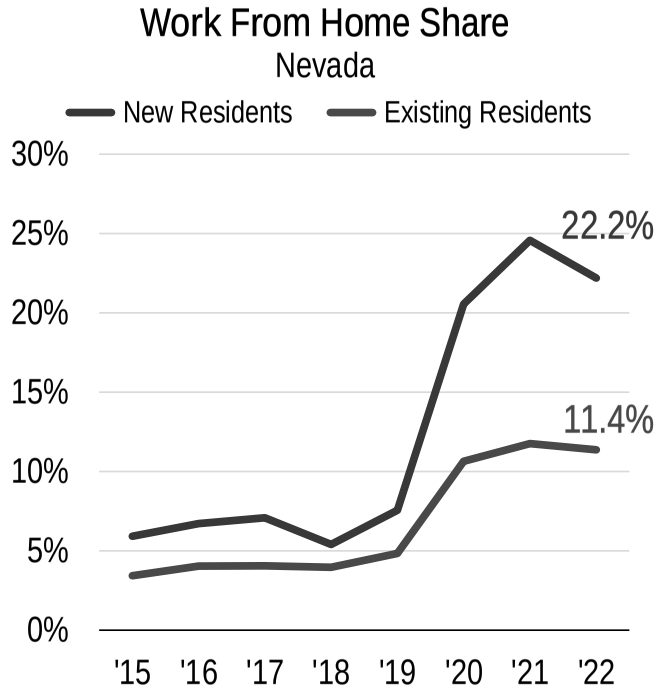
Migration to Northern Nevada			
County	Households	Share	Income
Clark County, NV	890	6.3%	$57,500
Lyon County, NV	580	4.2%	$54,900
Los Angeles County, CA	560	3.9%	$162,800
Santa Clara County, CA	520	3.5%	$62,600
Carson City, NV	490	3.4%	$258,200
Sacramento County, CA	470	3.6%	$347,100
Contra Costa County, CA	410	2.9%	$130,000
Placer County, CA	400	2.8%	$270,700
Alameda County, CA	350	2.5%	$85,200
Nevada County, CA	350	2.6%	$190,400

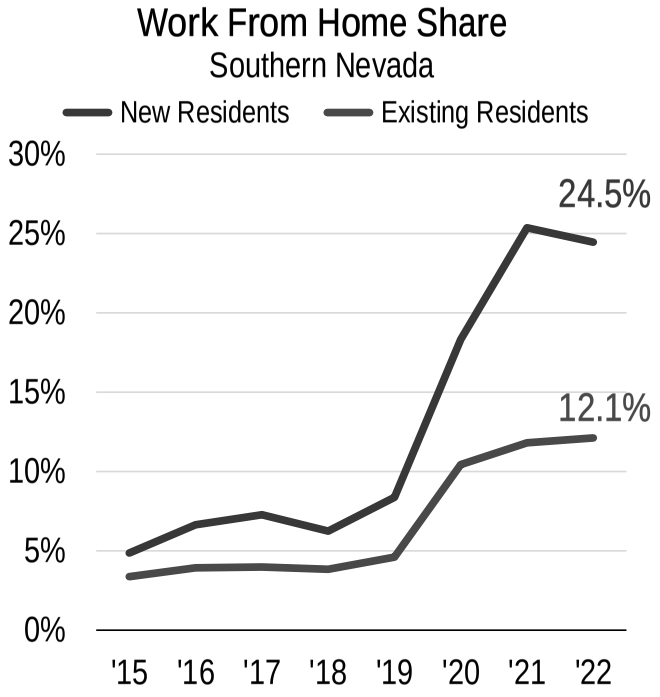
Source: U.S. Internal Revenue Service

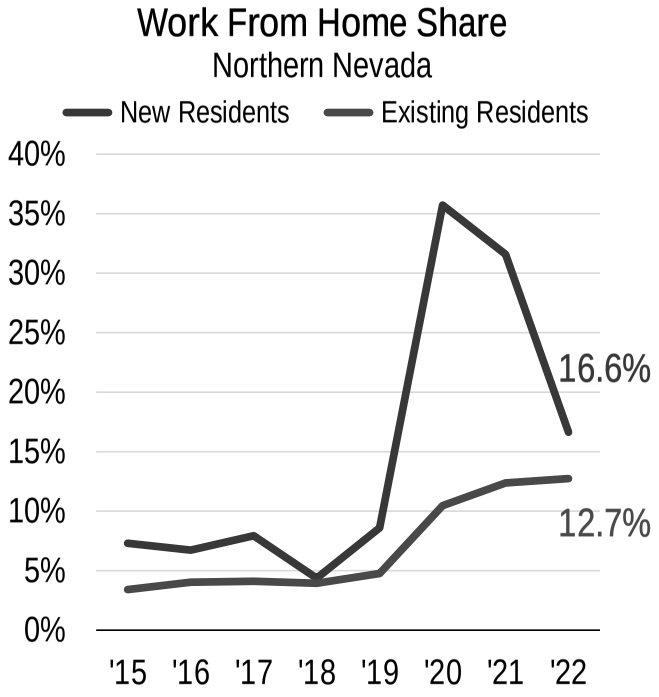
Work From Home

Nevada

Nevada's proximity to California and relatively affordable housing made it an attractive destination for movers who were able to work remotely. Since 2020, incoming residents were twice as likely to work from home than existing residents.







Source: IPUMS USA, University of Minnesota; Applied Analysis

Cost of Living

Among Western Metropolitan Areas

Nevada's lower cost of living has traditionally been a factor in the state's attractiveness as a relocation destination. The state's two major metropolitan areas are more affordable than other areas in the west.

Cost Of Living vs. Southern Nevada		
	Overall	Housing
San Francisco, CA	+74.2%	+176.5%
Los Angeles, CA	+52.6%	+125.7%
Seattle, WA	+48.2%	+102.2%
San Diego, CA	+45.5%	+105.6%
Portland, OR	+23.2%	+43.3%
Sacramento, CA	+22.3%	+34.4%
Denver, CO	+13.0%	+24.9%
Salt Lake City, UT	+11.4%	+17.9%
Phoenix, AZ	+4.4%	+11.5%

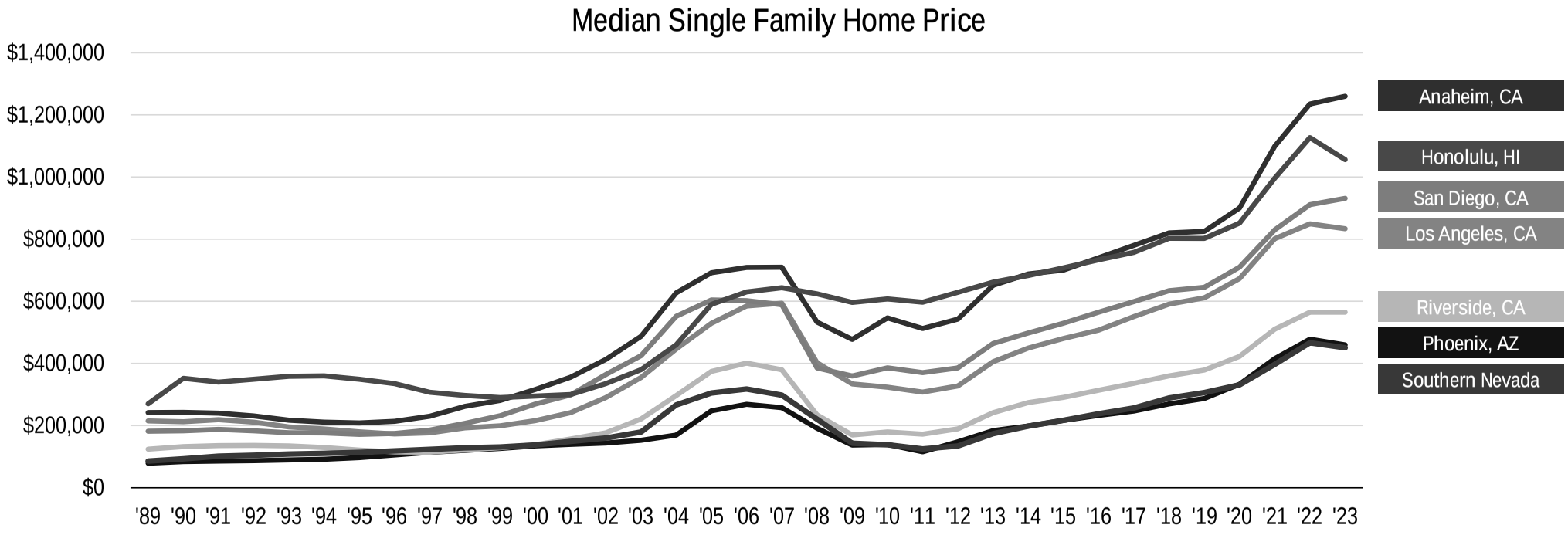
Cost Of Living vs. Northern Nevada		
	Overall	Housing
San Francisco, CA	+62.8%	+159.1%
Los Angeles, CA	+42.6%	+111.5%
Seattle, WA	+38.5%	+89.4%
San Diego, CA	+36.0%	+92.6%
Portland, OR	+15.1%	+34.3%
Sacramento, CA	+14.4%	+25.9%
Denver, CO	+5.7%	+17.0%
Salt Lake City, UT	+4.1%	+10.5%
Phoenix, AZ	-2.4%	+4.4%

Source: The Council for Community and Economic Research. Note: Data for 2024.

Housing Cost Comparison

Top Markets for Migration to Southern Nevada

Southern Nevada's relatively cheaper housing has long been a driving force for migration into the region for decades. The majority of new residents relocate from areas with significantly higher housing costs.

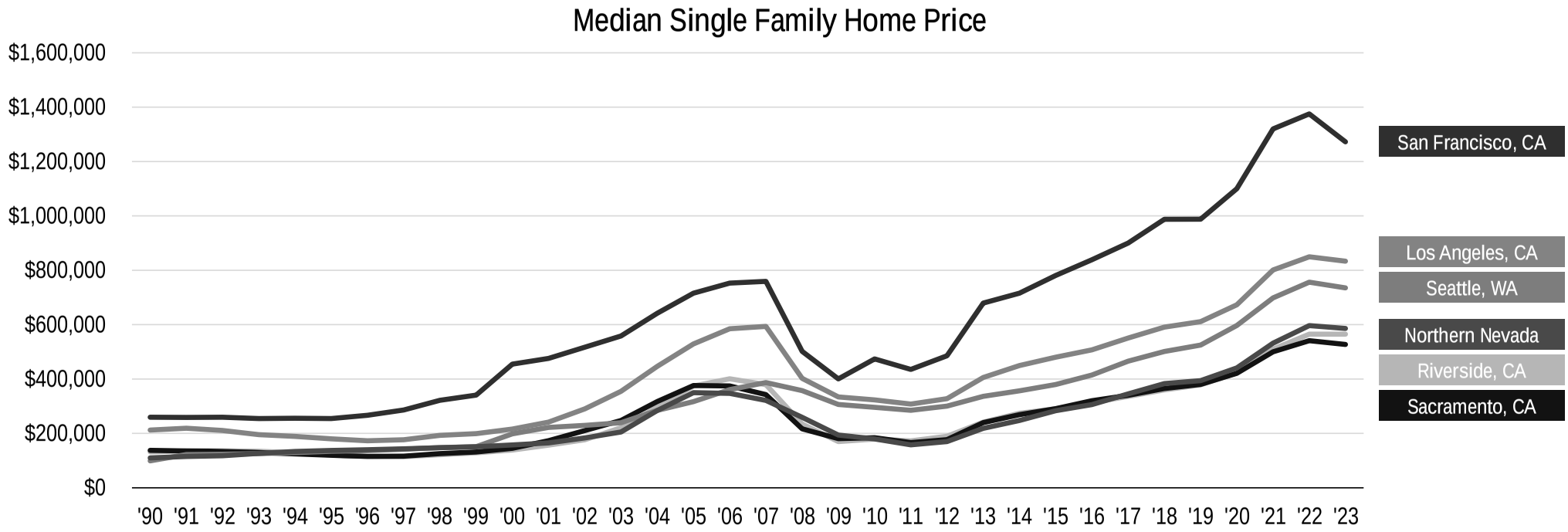


Source: National Association of Realtors

Housing Cost Comparison

Top Markets for Migration to Northern Nevada

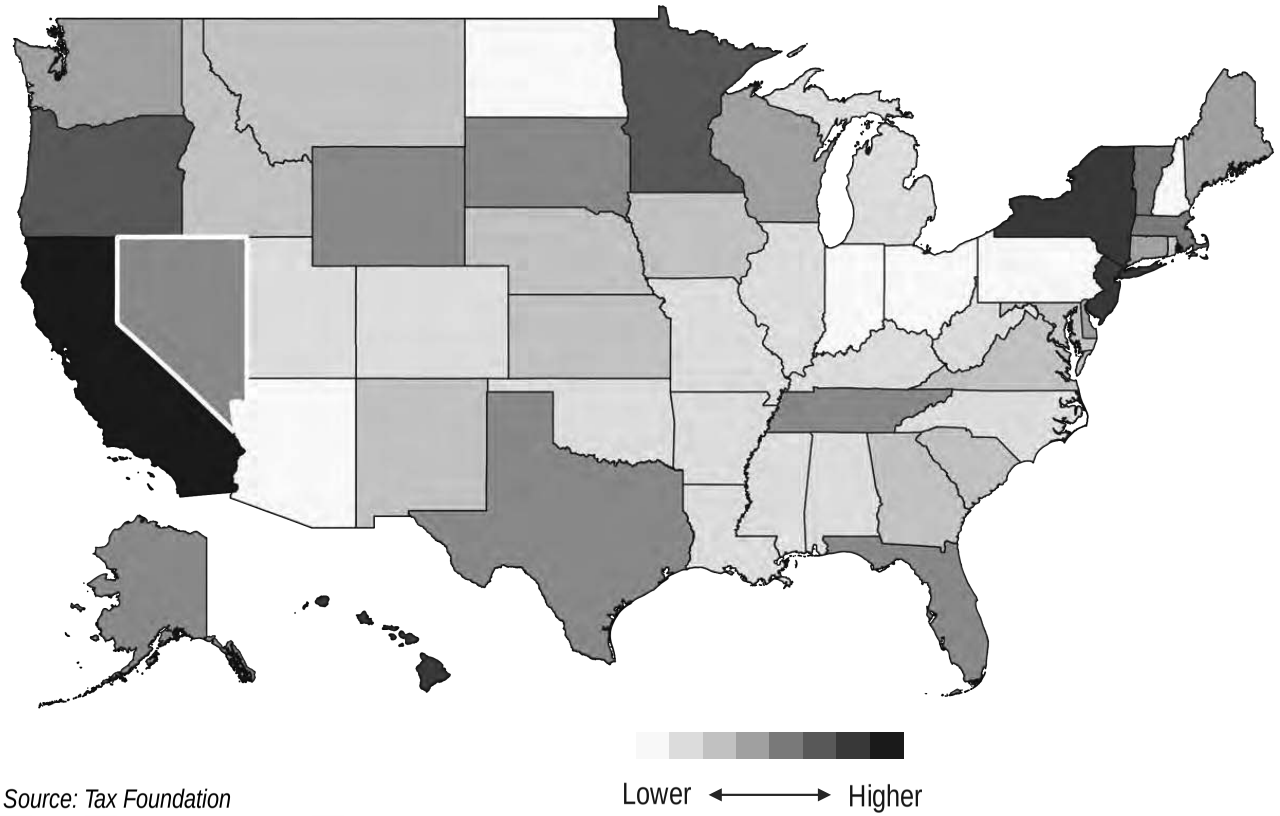
Housing costs in Northern Nevada run higher compared to Southern Nevada, yet they remain relatively cheaper than other markets along the West Coast where a high share of new residents relocate from.



Source: National Association of Realtors

Income Tax Comparison

Highest Marginal Tax Rate



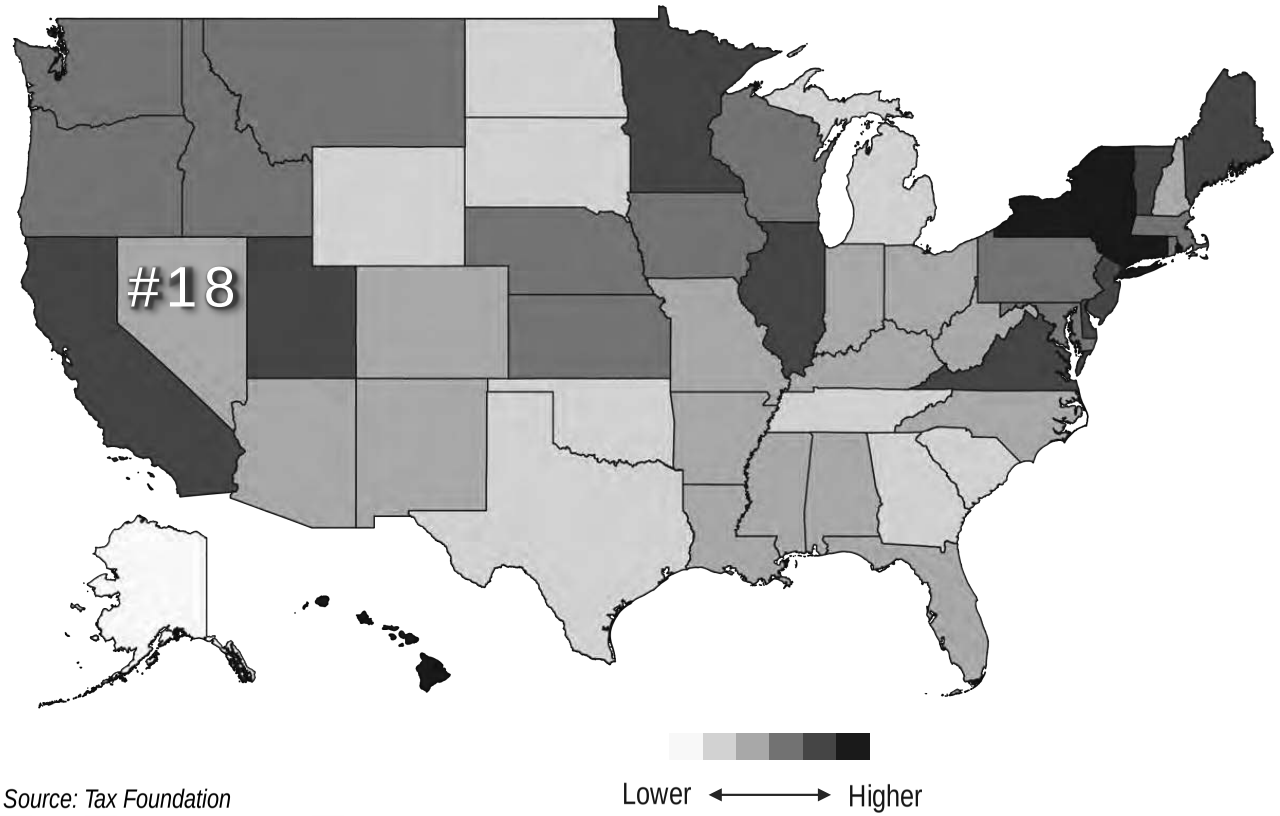
Source: Tax Foundation

Nevada is one of seven states with no personal income tax.

Neighboring California has the highest marginal income tax rate in the nation at 13.3 percent.

State and Local Tax Burden

The Tax Foundation's calculation of relative tax burdens divides total taxes paid by state residents by a state's share of net national product. For tourism-heavy states such as Nevada, the Tax Foundation allocates a portion of tourist-related taxes to visitors' states of origin.

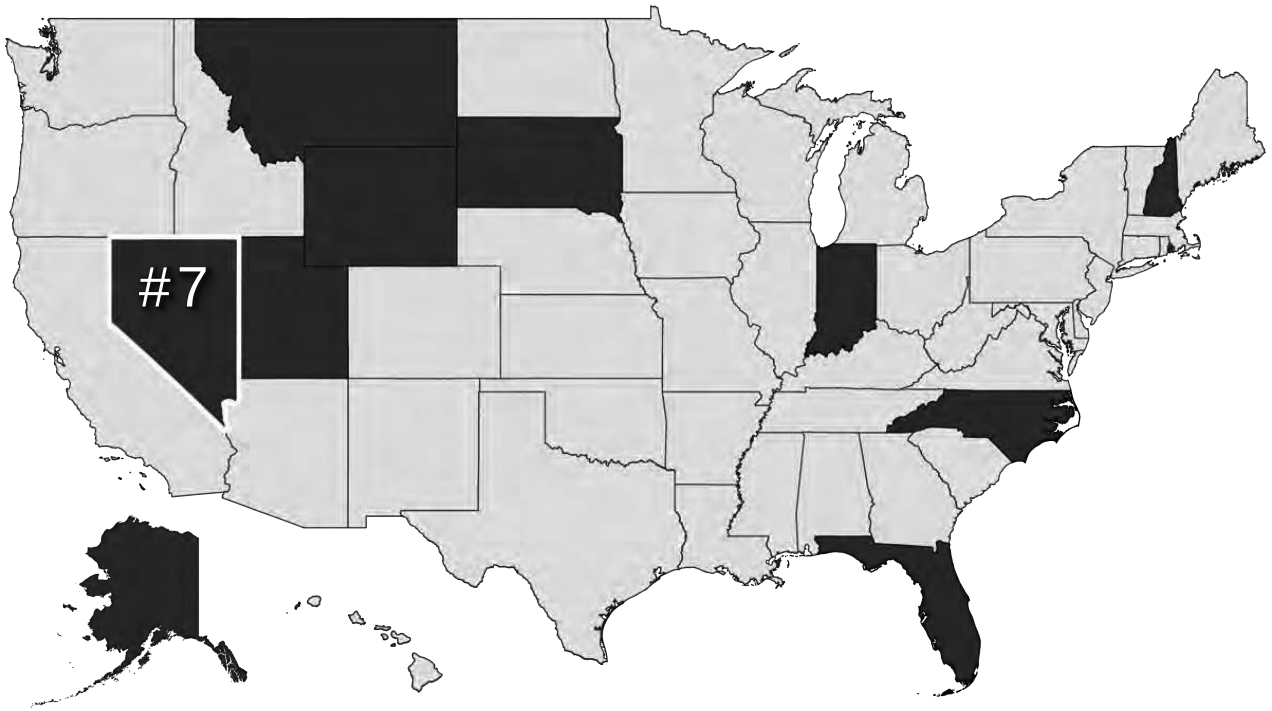


Source: Tax Foundation

RANK	STATE	EFFECTIVE TAX RATE
1	Alaska	4.6%
2	Wyoming	7.5%
3	Tennessee	7.6%
4	South Dakota	8.4%
5	Michigan	8.6%
6	Texas	8.6%
7	North Dakota	8.8%
8	Georgia	8.9%
9	South Carolina	8.9%
10	Oklahoma	9.0%
18	NEVADA	9.6%

Business Tax Climate

Top 10 States



RANK	STATE
1	Wyoming
2	South Dakota
3	Alaska
4	Florida
5	Montana
6	New Hampshire
7	NEVADA
8	Utah
9	North Carolina
10	Indiana

Source: Tax Foundation

Business Tax Climate

Component Rankings

State	Overall Rank	Corporate Tax Rank	Individual Income Tax Rank	Sales Tax Rank	Property Tax Rank	Unemployment Insurance Tax Rank
Wyoming	1	1	1	7	34	23
South Dakota	2	1	1	27	30	35
Alaska	3	26	1	5	27	48
Florida	4	11	1	19	13	4
Montana	5	23	28	3	19	22
New Hampshire	6	44	10	1	43	40
NEVADA	7	25	5	45	4	45
Utah	8	14	11	21	8	17
North Carolina	9	5	15	20	12	6
Indiana	10	12	16	18	3	25

Source: Tax Foundation

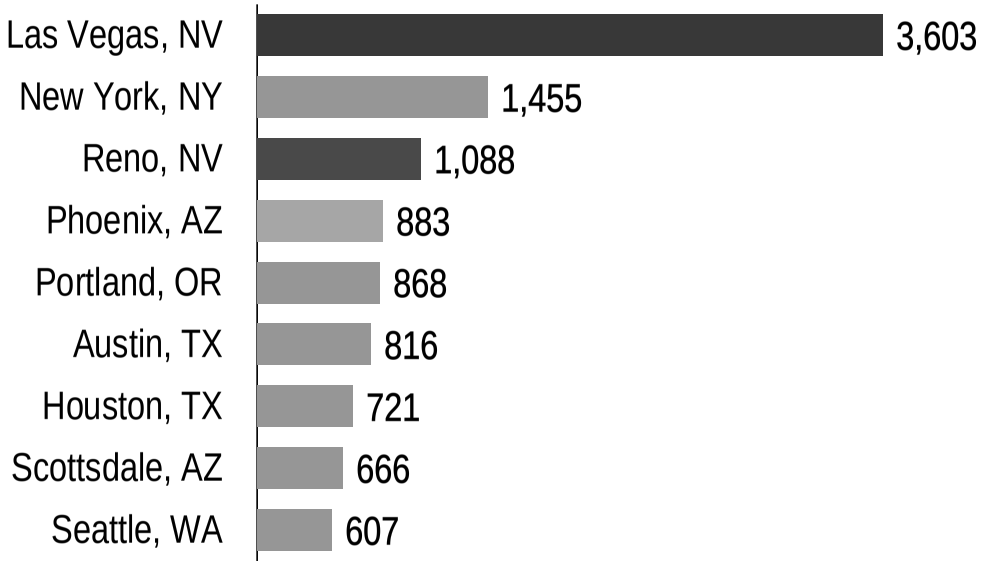
Migration

Business Relocation

Nevada and its two major metropolitan areas have been top destinations for businesses leaving California and other states.

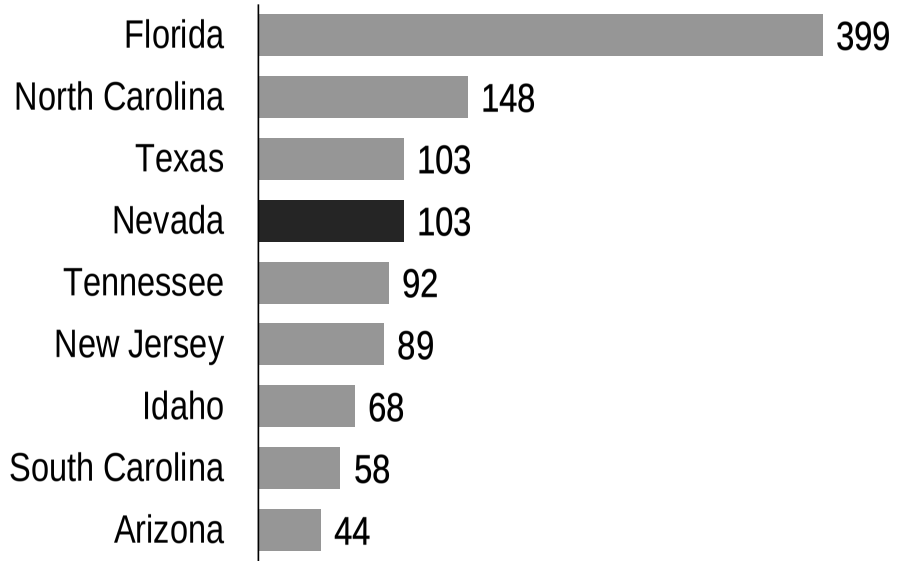
Top 10 Destination Cities

For Businesses Leaving California – 1990-2019



Top 10 Destination States

For All Business Relocations – 2021



Source: Claremont McKenna College 2022 Cost of Doing Business Survey; U.S. Bureau of Labor Statistics. Note: Aggregate number of moves based on 1990-2019 data.

LABOR MARKET

INCOME AND SPENDING

TOURISM

HOUSING MARKET

POPULATION AND MIGRATION

DEVELOPMENT PIPELINE

$22B+

Total Value Of Completions In Southern Nevada Since 2020

The investments listed in this report reflect large singular projects. A significant amount of investment in numerous residential and commercial developments is not included here.

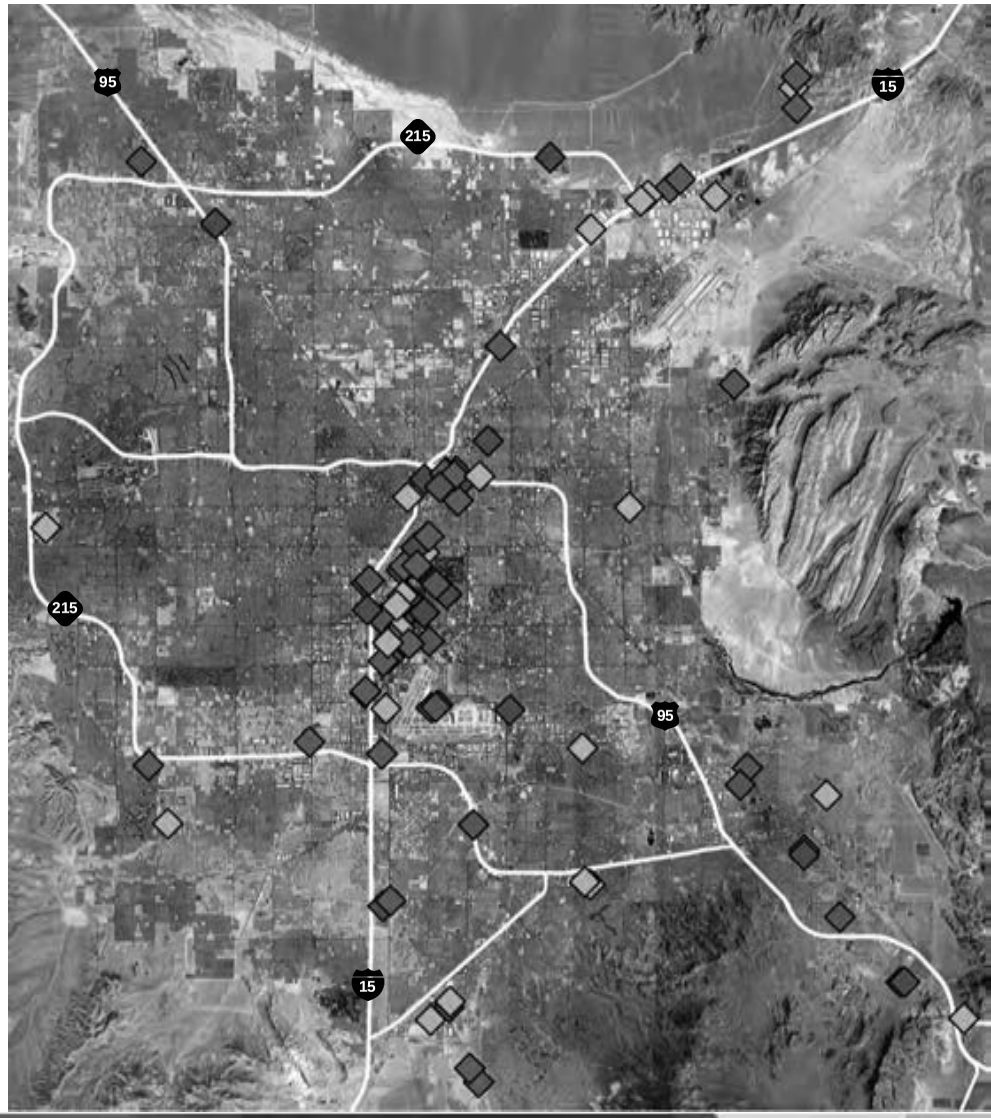
Source: vegasdevmap.com

Southern Nevada Completions

By Year

SYMBOL	YEAR	TOTAL COMPLETIONS	TOTAL VALUE
◆	2020	24	$4.9 Billion
◆	2021	17	$6.2 Billion
◆	2022	24	$1.3 Billion
◆	2023	27	$9.9 Billion
	Total	92	$22.3 Billion

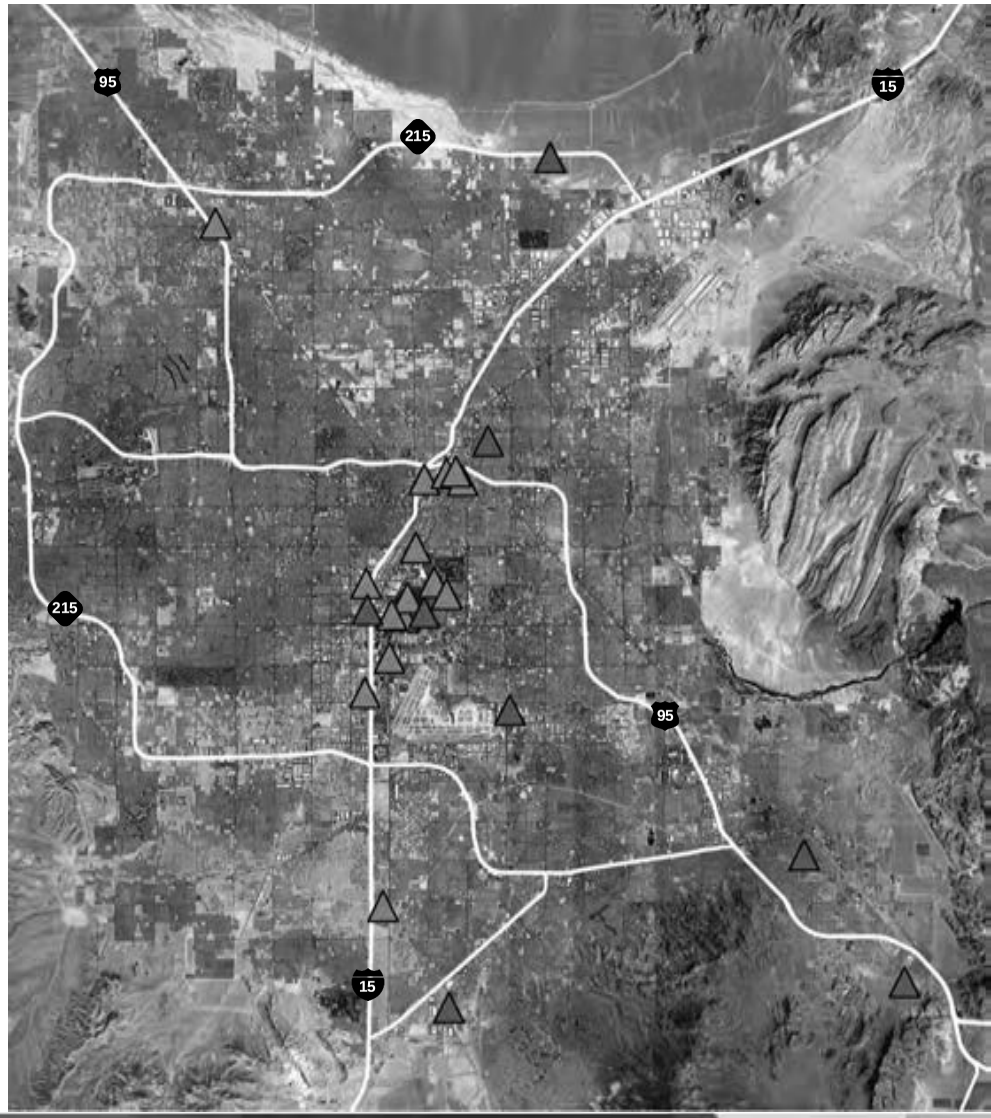
Source: vegasdevmap.com. Note: Not all completed projects disclosed capital costs. Values are estimates.



Southern Nevada Completions

2020 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Tourism	15	$4.5 Billion
▲ Non-Tourism	7	$297.3 Million
▲ Transportation	2	$128.6 Million
Total	24	$4.9 Billion

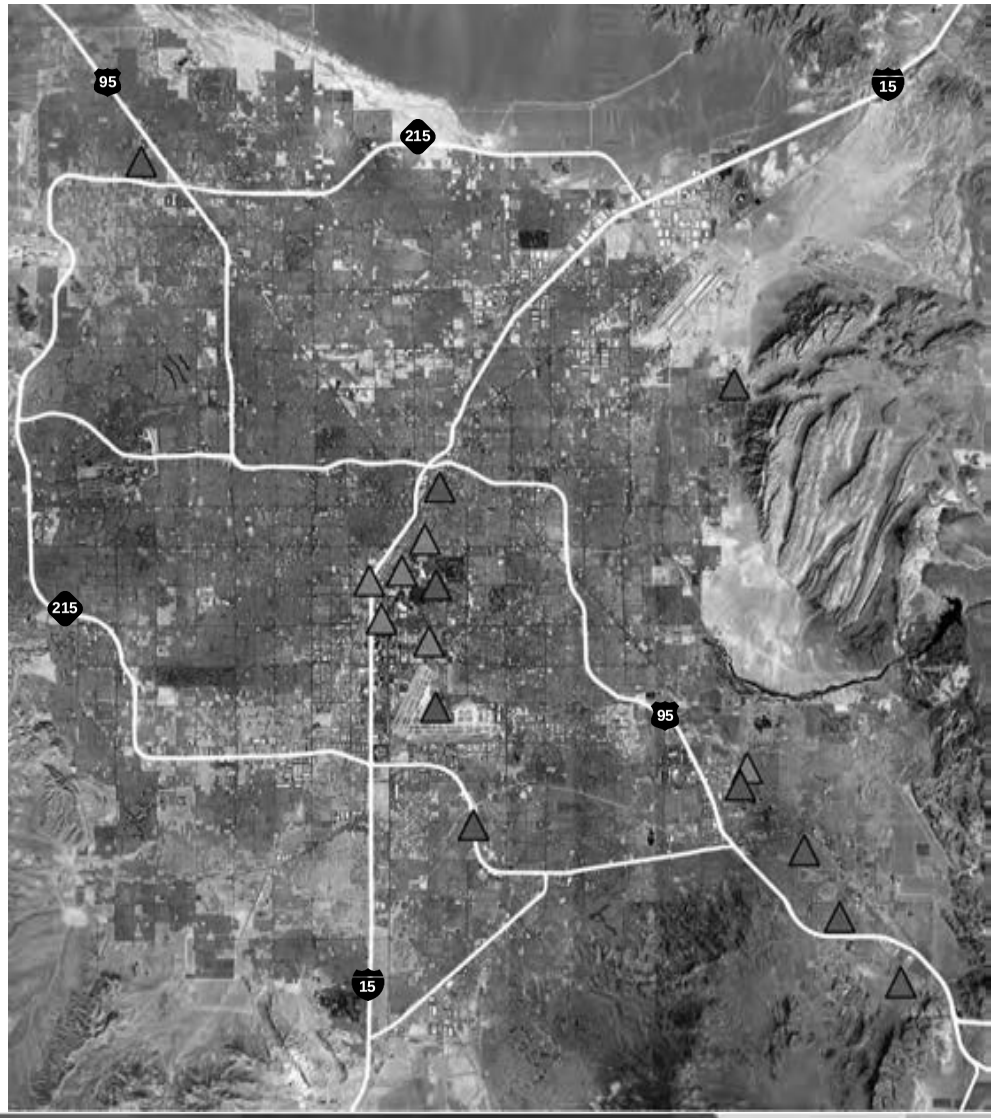


Source: vegasdevmap.com. Note: Not all completed projects disclosed capital costs. Values are estimates.

Southern Nevada Completions

2021 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Tourism	6	$4.6 Billion
▲ Non-Tourism	8	$1.5 Billion
▲ Transportation	3	$95.1 Million
Total	17	$6.2 Billion

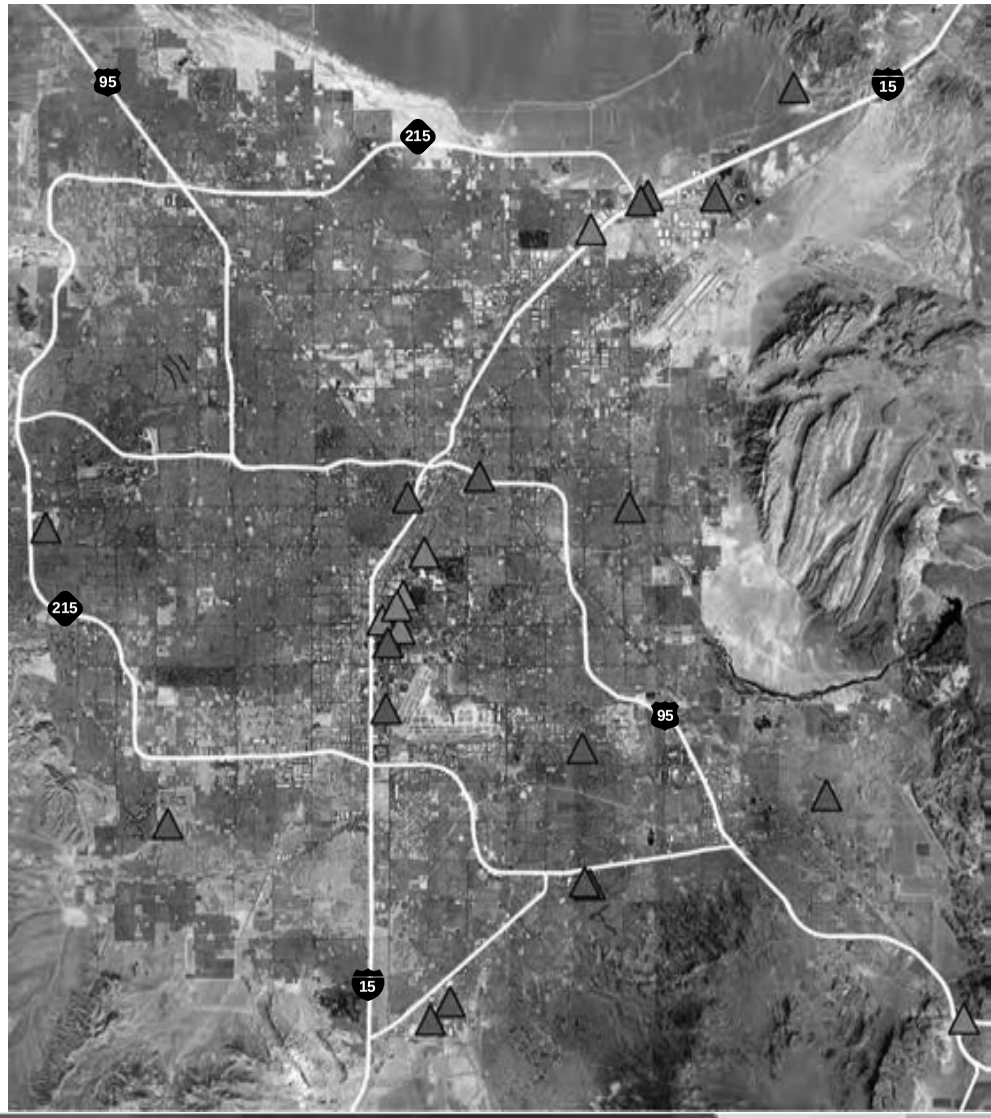


Source: vegasdevmap.com. Note: Not all completed projects disclosed capital costs. Values are estimates.

Southern Nevada Completions

2022 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Tourism	7	$353.0 Million
▲ Non-Tourism	12	$735.4 Million
▲ Transportation	5	$216.4 Million
Total	24	$1.3 Billion

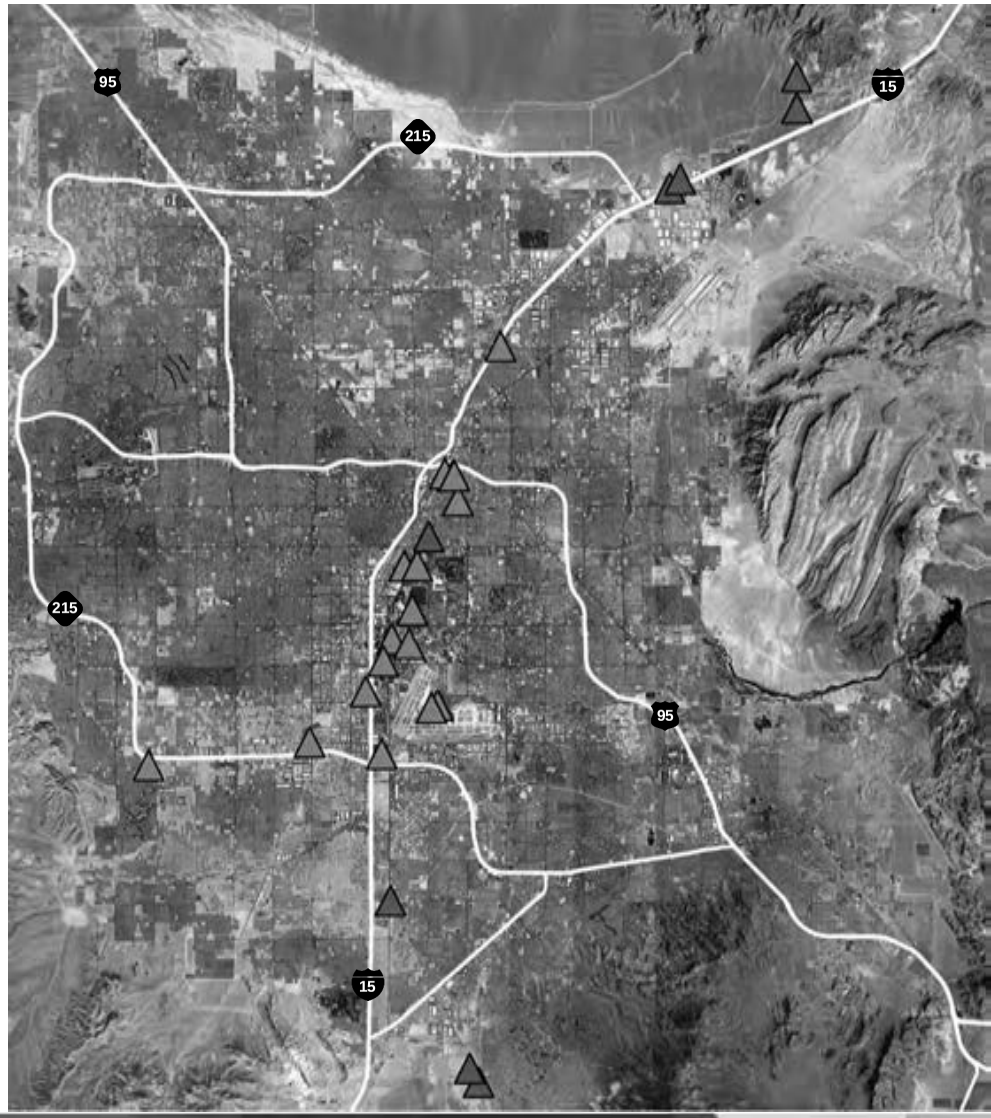


Source: vegasdevmap.com. Note: Not all completed projects disclosed capital costs. Values are estimates.

Southern Nevada Completions

2023 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Tourism	17	$7.7 Billion
▲ Non-Tourism	8	$2.0 Billion
▲ Transportation	2	$163.0 Million
Total	**27**	**$9.9 Billion**



Source: vegasdevmap.com. Note: Not all completed projects disclosed capital costs. Values are estimates.

Southern Nevada

Completions | Tourism-Related Projects

PROJECT	COST	STATUS	YEAR
Resorts World Las Vegas	$4.3 B	Completed	2021
Fontainebleau	$3.9 B	Completed	2023
MSG Sphere	$2.3 B	Completed	2023
Allegiant Stadium	$2.0 B	Completed	2020
Las Vegas Convention Center Expansion	$1.4 B	Completed	2020
Durango Casino & Resort	$780.0 M	Completed	2023
Formula 1 Paddock Club	$500.0 M	Completed	2023
Wynn Convention Center	$425.0 M	Completed	2020
Caesars FORUM Conference Center	$375.0 M	Completed	2020
Virgin Hotels Las Vegas (rebrand of Hard Rock Hotel & Casino)	$200.0 M	Completed	2021
Wynn Resorts Room Remodel	$200.0 M	Completed	2022
SAHARA Las Vegas (Rebrand of SLS Las Vegas)	$150.0 M	Completed	2022
The STRAT Hotel & Casino Rebrand	$110.0 M	Completed	2021
Expo at World Market Center Las Vegas	$90.0 M	Completed	2020
New York-New York Room Remodel	$63.0 M	Completed	2023
Hampton Inn & Suites/Home2Suites	$55.0 M	Completed	2020
Fremont Hotel and Casino Expansion	$50.0 M	Completed	2023
Downtown Grand Hotel & Casino Third Tower	$45.0 M	Completed	2020

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada

Completions | Tourism-Related Projects

PROJECT	COST	STATUS	YEAR
South Point Hotel Casino & Spa Renovation	$40.0 M	Completed	2020
Circus Circus Hotel, Casino and Theme Park Renovations	$30.0 M	Completed	2023
The Beverly Theater	$30.0 M	Completed	2023
El Cortez Hotel and Casino Renovations	$21.0 M	Completed	2020
Harry Reid International Airport Renovations	$16.4 M	Completed	2023
Aloft Hotel	$12.0 M	Completed	2023
Skyline Hotel & Casino Expansion	$7.0 M	Completed	2021
Allegiant Stadium Renovations	$6.0 M	Completed	2023
Bollard Installation at Harry Reid International Airport	$4.9 M	Completed	2023
Downtown Las Vegas Pedestrian Mall	$4.5 M	Completed	2023
Caesars Palace Entrance Renovations	$3.0 M	Completed	2022
Showcase Mall Expansion	$1.2 M	Completed	2020
AREA15	DND	Completed	2020
Circa Resort and Casino	DND	Completed	2020
Fairfield Inn by Marriott	DND	Completed	2020
Harrah's Las Vegas Hotel and Casino Room Renovations	DND	Completed	2020
Ahern Hotel & Convention Center (Rebrand of Lucky Dragon Hotel & Casino)	DND	Completed	2020
TownePlace Suites	DND	Completed	2022

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada

Completions | Tourism-Related Projects

PROJECT	COST	STATUS	YEAR
AREA15 Expansion	DND	Completed	2021
SpringHill Suites Marriott Airport	DND	Completed	2023
Remodel of Nobu Boutique Hotel	DND	Completed	2021
Horseshoe Las Vegas	DND	Completed	2022
Miracle Mile Shops Renovation	DND	Completed	2023
Tao Beach Club Renovation	DND	Completed	2022
Ojos Locos Sports Cantina and Fifth Street Gaming Hotel	DND	Completed	2023
Holiday Inn Express at Railroad Pass Casino	DND	Completed	2022
Plaza Hotel & Casino Renovations	DND	Completed	2023

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada

Completions | Non-Tourism-Related Projects

PROJECT	COST	STATUS	YEAR
Google Data Center	$1.2 B	Completed	2021
Gemini Solar Project	$1.2 B	Completed	2023
Novva Data Centers	$400.0 M	Completed	2023
Air Liquide Hydrogen Production Site	$250.0 M	Completed	2022
Smith's Distribution Center	$225.0 M	Completed	2023
Kirk Kerkorian School of Medicine at UNLV	$150.0 M	Completed	2022
1700 Pavilion	$120.4 M	Completed	2022
Elysian at the Hughes Center	$100.0 M	Completed	2020
Matter Logistics @ North 15	$100.0 M	Completed	2023
HEYDUDE Distribution (Crocs)	$85.0 M	Completed	2023
Dollar Loan Center	$84.0 M	Completed	2022
CSN Betty Engelstad Health Science Building	$77.0 M	Completed	2021
Intermountain Healthcare Performance Center	$75.0 M	Completed	2020
Luxury Apartments at Twain/Dean Martin	$65.0 M	Completed	2020
Nevada State College Education Building	$61.8 M	Completed	2021
New Las Vegas Municipal Courthouse	$56.0 M	Completed	2021
Downtown Henderson	$50.0 M	Completed	2021
Nuro Assembly Facility and Test Site	$40.0 M	Completed	2022

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada

Completions | Non-Tourism-Related Projects

PROJECT	COST	STATUS	YEAR
Evanesce Packing Solutions	$30.0 M	Completed	2022
Lifeguard Arena in Henderson	$25.0 M	Completed	2020
Metropolitan Police Department Reality Based Training Center	$25.0 M	Completed	2021
Smith's Marketplace in Henderson	$24.0 M	Completed	2022
Nevada State College Dorms	$20.0 M	Completed	2020
Centennial Hills Hospital Expansion	$18.2 M	Completed	2021
ENTEK Manufacturing Plant	$15.0 M	Completed	2022
Archie Grant Park Affordable Housing Renovations	$12.3 M	Completed	2020
Collaboration Center Foundation's LV Ranch	$12.0 M	Completed	2022
CSN Center Of Excellence	$12.0 M	Completed	2023
Las Vegas Metropolitan Police Department Facility Expansion	$10.0 M	Completed	2022
Lee Canyon Upgrades	$7.0 M	Completed	2023
MGM-Invenergy Solar Project	DND	Completed	2021
WVC (Rebrand and Renovation of Enclave)	DND	Completed	2020
Las Vegas Aces Headquarters	DND	Completed	2022
Green Valley Library Renovation	DND	Completed	2022
LVMPD K-9 Operations Center	DND	Completed	2023

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada

Completions | Transportation-Related Projects

PROJECT	COST	STATUS	YEAR
I-15/CC-215 Northern Beltway Interchange	$139.0 M	Completed	2022
Downtown Las Vegas Roadwork	$125.0 M	Completed	2023
New 215 Beltway Interchanges at Losee, Pecos, and Lamb	$70.0 M	Completed	2020
Blue Diamond Widening	$58.6 M	Completed	2020
Las Vegas Convention Center Loop	$52.5 M	Completed	2021
I-515 Viaduct Rehabilitation Project	$40.0 M	Completed	2022
Via Nobila Road Construction	$38.0 M	Completed	2023
Nellis Boulevard Road Work	$34.0 M	Completed	2022
I-215 Beltway Widening	$29.6 M	Completed	2021
McCarran Airport Infrastructure Improvements	$13.0 M	Completed	2021
Dollar Loan Center Roadwork	$3.4 M	Completed	2022
Harmon and Las Vegas Blvd Pedestrian Bridge	DND	Completed	2022

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.


$31B+
UNDER CONSTRUCTION &
PLANNED INVESTMENTS

Southern Nevada Development Pipeline

Planned and UC Investments

PROJECT STATUS	TOTAL PROJECTS	TOTAL VALUE
Under Construction	43	$10.9 Billion
▲ Tourism	17	$3.6 Billion
▲ Non-Tourism	20	$6.7 Billion
▲ Transportation	6	$622.3 Million
Planned	44	$20.3 Billion
▲ Tourism	22	$13.3 Billion
▲ Non-Tourism	17	$3.4 Billion
▲ Transportation	5	$3.6 Billion
Total	87	$31.2 Billion

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Investment Breakdown

Las Vegas Area

Source: vegasdevmap.com

Oak View Group
Arena & Hotel-Casino

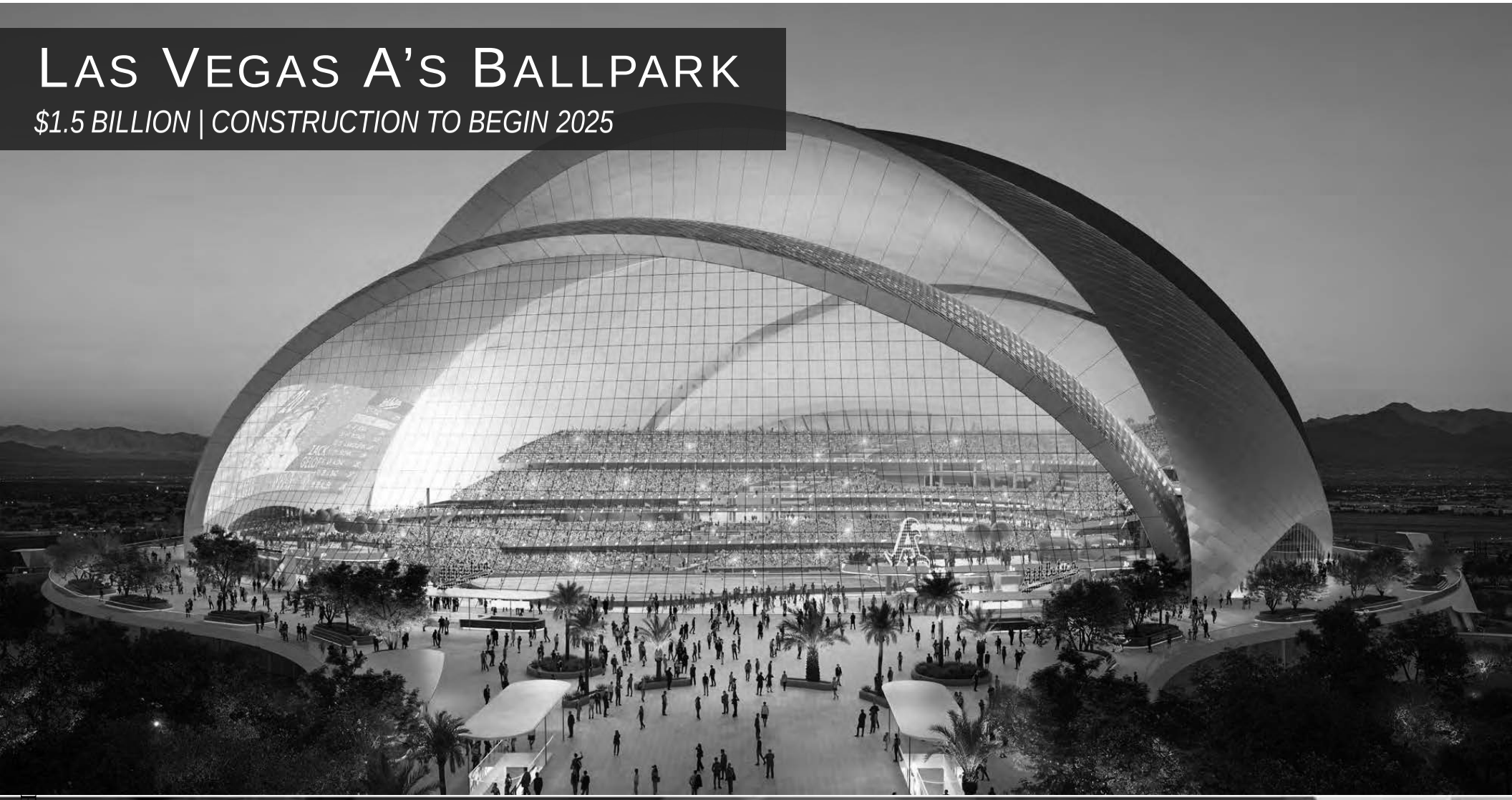
$10.0 BILLION | PLANNED

BRIGHTLINE HIGH-SPEED RAIL

$3.0 BILLION | PLANNED

Las Vegas A's Ballpark

$1.5 BILLION | CONSTRUCTION TO BEGIN 2025



Four Seasons Private Residences

$1.0 BILLION | PLANNED

Hard Rock Rebrand Of The Mirage

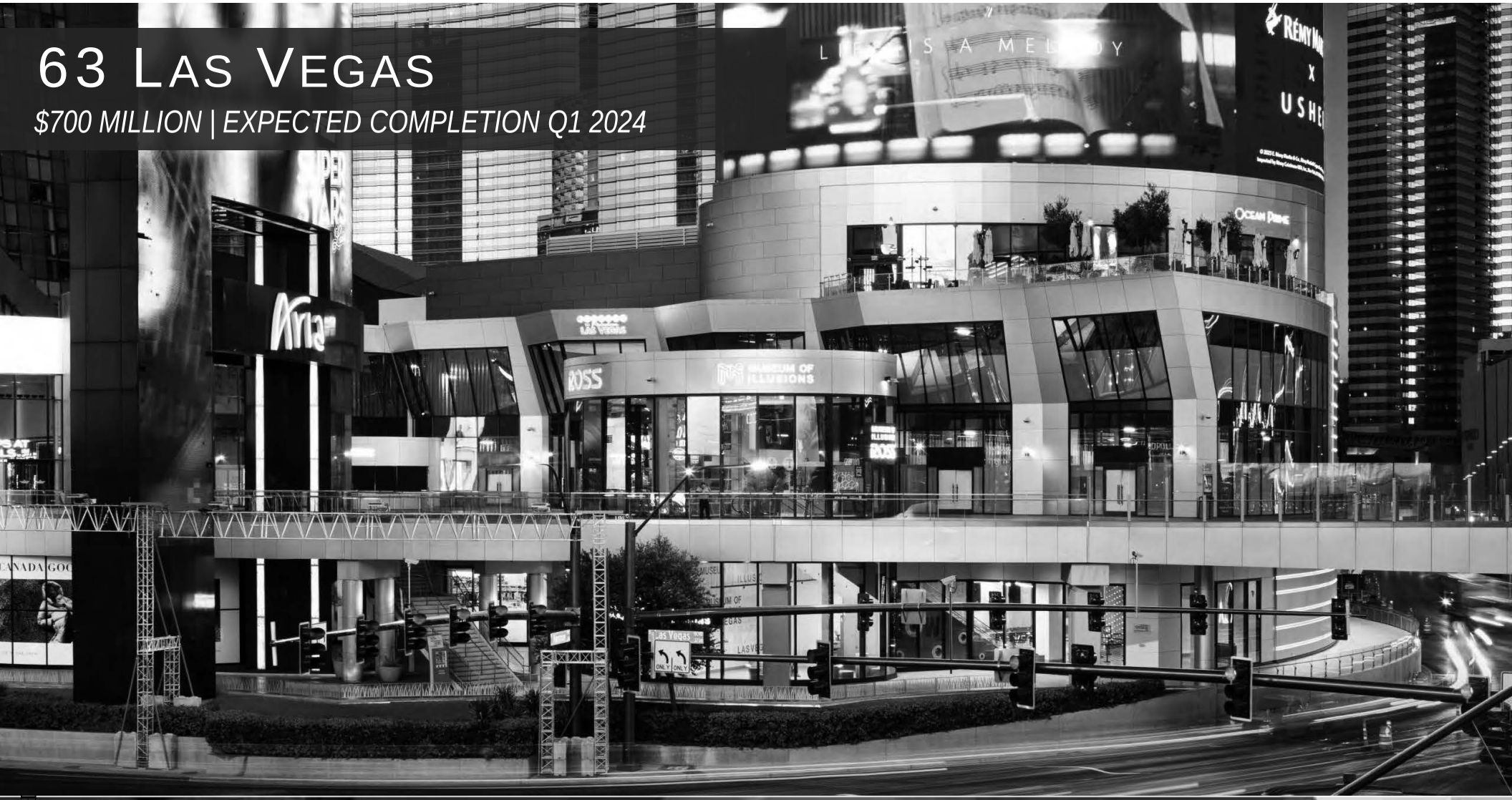
EXPECTED COMPLETION 2026

MAJESTIC LAS VEGAS

$850 MILLION | PLANNED

63 Las Vegas

$700 MILLION | EXPECTED COMPLETION Q1 2024



I-15 Tropicana Project

$305.0 MILLION | EXPECTED COMPLETION 2025

Southern Nevada Investment Activity

Under Construction | Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Venetian Renovations	$1.0 B	Under Construction	2026
63 Las Vegas	$700.0 M	Under Construction	Q1 2024
Las Vegas Convention Center North, Central and South Exhibition Halls Renovation	$600.0 M	Under Construction	2025
Rio All-Suite Hotel & Casino/Hyatt Regency Renovations	$350.0 M	Under Construction	2025
M Resort Expansion	$206.0 M	Under Construction	TBD
Delta by Marriott	$100.0 M	Under Construction	July 2025
Mandalay Bay Convention Center Renovation	$100.0 M	Under Construction	2024
Versailles Tower at Paris	$100.0 M	Under Construction	Q1 2024
AC Hotel by Marriott and Element	$95.0 M	Under Construction	2025
Otonomous Hotel	$85.0 M	Under Construction	Q4 2024
Atomic Range	$75.0 M	Under Construction	2023
Silverton Casino Hotel Room Renovations	$50.0 M	Under Construction	2024
Swingers Adult Mini-Golf	$50.0 M	Under Construction	2024
Harry Reid Baggage Claim Renovation	$31.0 M	Under Construction	2026
Atwell Suites at The Pass Casino	$20.0 M	Under Construction	2024
Flamingo Mixed-Use Development	DND	Under Construction	TBD
BLVD Retail Center	DND	Under Construction	2025

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Under Construction | Non-Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Project Helios	$5.0 B	Under Construction	2034
Evora	$500.0 M	Under Construction	2026
UnCommons	$400.0 M	Under Construction	2023
UHS Henderson Hospital	$385.0 M	Under Construction	2024
Water Pipeline to Apex Industrial Park	$130.0 M	Under Construction	2028
Fore Apartment Complex and Mixed-Use Development	$70.0 M	Under Construction	TBD
The Bend	$60.0 M	Under Construction	2025
The Watermark	$50.0 M	Under Construction	TBD
NLV Village	$35.0 M	Under Construction	2024
Downtown Post Office Commercial Remodel	$30.0 M	Under Construction	2023
Silverado Ranch Community Center	$20.0 M	Under Construction	2024
Simmons Airpark	$18.0 M	Under Construction	December 2024
ER at Cadence	$15.8 M	Under Construction	July 2024
Ice Age Fossils State Park	$3.5 M	Under Construction	2023
Jean Industrial Park	DND	Under Construction	2024
The Ellison Apartments	DND	Under Construction	2024
Ainsley Apartments at The Collective	DND	Under Construction	TBD
PopStroke Mini-Golf	DND	Under Construction	Q1 2024

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Under Construction | Non-Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
H-Mart	DND	Under Construction	2024
Southern Land Co. Apartment Complex	DND	Under Construction	2025

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Under Construction | Transportation-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
I-15 Tropicana Project	$305.0 M	Under Construction	2025
I-15 South Project	$86.0 M	Under Construction	January 2026
Las Vegas Boulevard Repaving	$73.0 M	Under Construction	May 2024
I-15 North Widening Phase 3	$71.5 M	Under Construction	Q1 2024
U.S. 95 Corridor Improvements	$46.8 M	Under Construction	2024
Sahara and Las Vegas Blvd Pedestrian Bridge	$40.0 M	Under Construction	2024

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Planned | Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Oak View Group Arena and Hotel-Casino	$10.0 B	Planned	2026
A's Stadium	$1.5 B	Planned	2028
Majestic Las Vegas	$850.0 M	Planned	2027
Hylo Park	$380.0 M	Planned	TBD
Nuance Las Vegas Hotel & Spa at Allegiant Stadium	$275.0 M	Planned	TBD
Nevada Museum of Art, Las Vegas	$217.0 M	Planned	2025
Bottled Blonde	$50.0 M	Planned	2024
Huntridge Theater Renovation	$22.0 M	Planned	2024
Boring Company Loop - Allegiant Stadium	$9.2 M	Planned	TBD
Boring Company Loop - Caesars Palace	$3.4 M	Planned	TBD
Neon Museum Expansion	$3.0 M	Planned	2025
SpringHill Suites Marriott	DND	Planned	January 2028
The Element Hotel by Westin	DND	Planned	January 2025
Mardi Gras Hotel and Casino Redevelopment	DND	Planned	2025
Atari Hotel	DND	Planned	TBD
Marnell West Henderson Casino	DND	Planned	TBD
Hard Rock Rebrand of the Mirage	DND	Planned	2026
Station Casino's North Las Vegas Resort	DND	Planned	TBD

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Planned | Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Fertitta Entertainment Casino/Hotel Project	DND	Planned	TBD
Universal Studios Horror Unleashed	DND	Planned	TBD
Station Casinos Inspirada	DND	Planned	TBD
Southern Nevada Supplemental Airport	DND	Planned	TBD

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Planned| Non-Tourism-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Four Seasons Private Residencies	$1.0 B	Planned	2026
Henderson West	$950.0 M	Planned	Q4 2028
Desert Pines Mixed-Use Development	$500.0 M	Planned	TBD
Haas Automation Manufacturing Plant	$327.0 M	Planned	2026
Campus Village	$190.0 M	Planned	TBD
City of Las Vegas Civic Plaza	$165.0 M	Planned	2025
NLV Gateway	$150.0 M	Planned	Q4 2024
UNLV Medical District Hotel	$60.7 M	Planned	November 2024
Skyline	$50.0 M	Planned	2026
Legal Aid Center of Southern Nevada Expansion	$30.0 M	Planned	TBD
ShareDowntown in Historic Westside	$22.0 M	Planned	2025
Boyd Gaming Las Vegas Headquarters	DND	Planned	TBD
Rockefeller Distribution Center	DND	Planned	TBD
Origin at Symphony Park	DND	Planned	TBD
Midtown	DND	Planned	2025
Aldi - Green Valley	DND	Planned	TBD
Aldi - Southwest Rainbow	DND	Planned	TBD

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Southern Nevada Investment Activity

Planned | Transportation-Related Projects

PROJECT	COST	STATUS	EST. COMPLETION
Brightline High-Speed Rail	$3.0 B	Planned	2027
Henderson Interchange	$350.0 M	Planned	2026
Widening of the 215 and insertion of DDI	$111.0 M	Planned	TBD
Widening of 215 Beltway between Interstate I-15 and Decatur Boulevard	$84.5 M	Planned	2025
Bellagio and Las Vegas Boulevard Pedestrian Bridge	$18.0 M	Planned	TBD

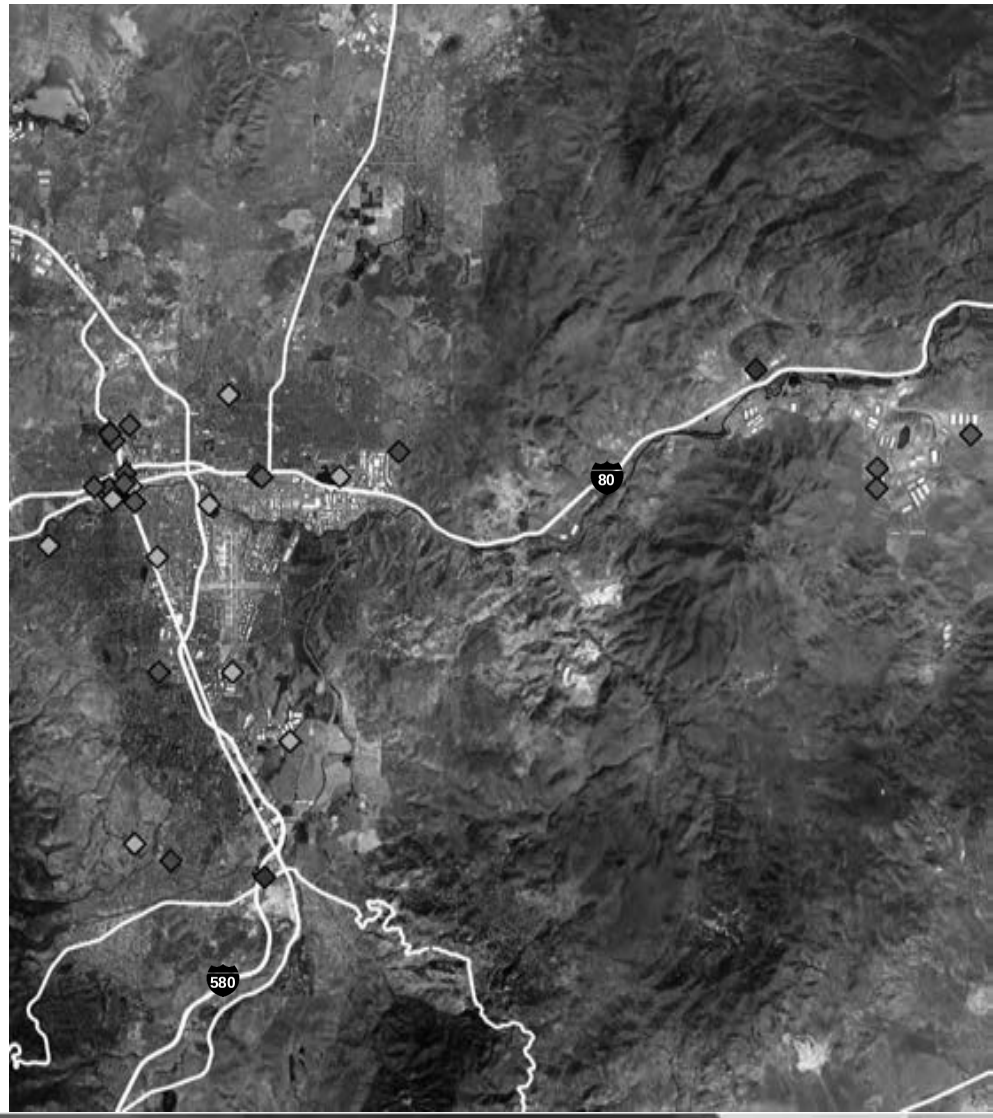
Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.


$8B+
TOTAL VALUE OF COMPLETIONS
IN NORTHERN NEVADA SINCE 2019
The investments listed in this report reflect large singular projects. A significant amount of investment in numerous residential and commercial developments is not included here.

Northern Nevada Completions

By Year

SYMBOL	YEAR	TOTAL INVESTMENTS	TOTAL VALUE
◆	2019	2	$90.0 Million
◆	2020	6	$243.5 Million
◆	2021	10	$1.0 Billion
◆	2022	12	$897.3 Million
◆	2023	7	$6.2 Billion
	Total	37	$8.4 Billion

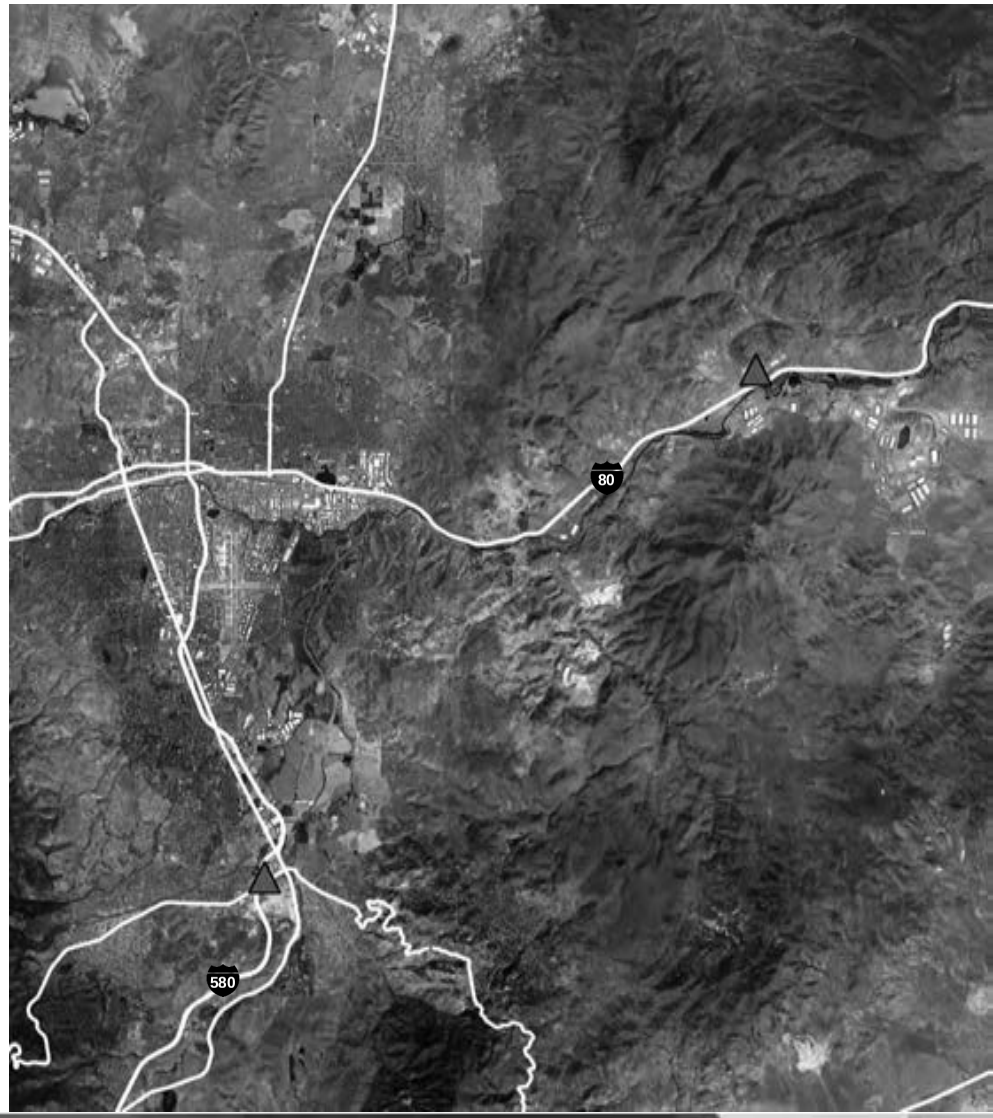


Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Completions

2019 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Privately Funded	2	$90.0 Million
Total	2	$90.0 Million

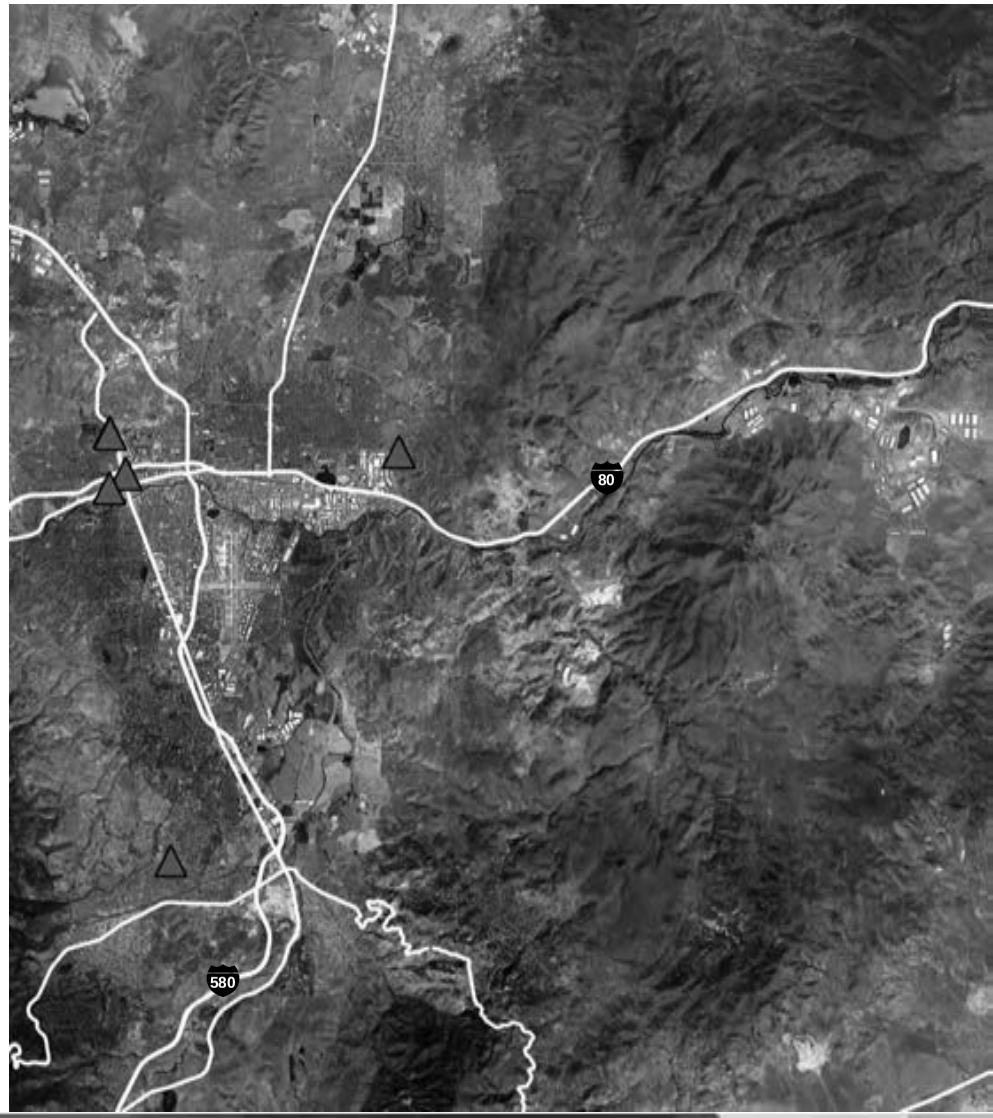


Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Completions

2020 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Privately Funded	5	$158.5 Million
▲ Publicly Funded	1	$85.0 Million
Total	6	$243.5 Million

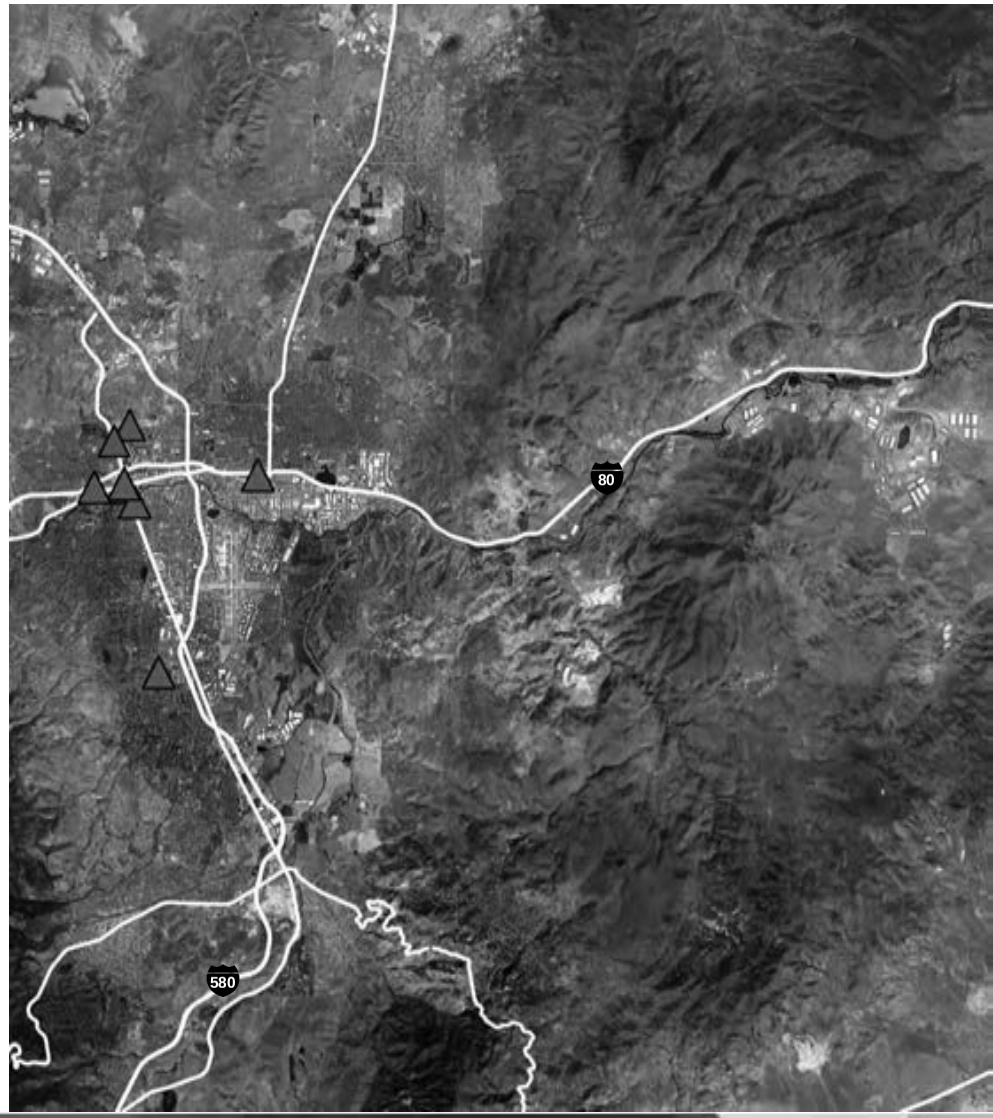


Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Completions

2021 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Privately Funded	7	$824.4 Million
▲ Publicly Funded	3	$179.2 Million
Total	10	$1.0 Billion

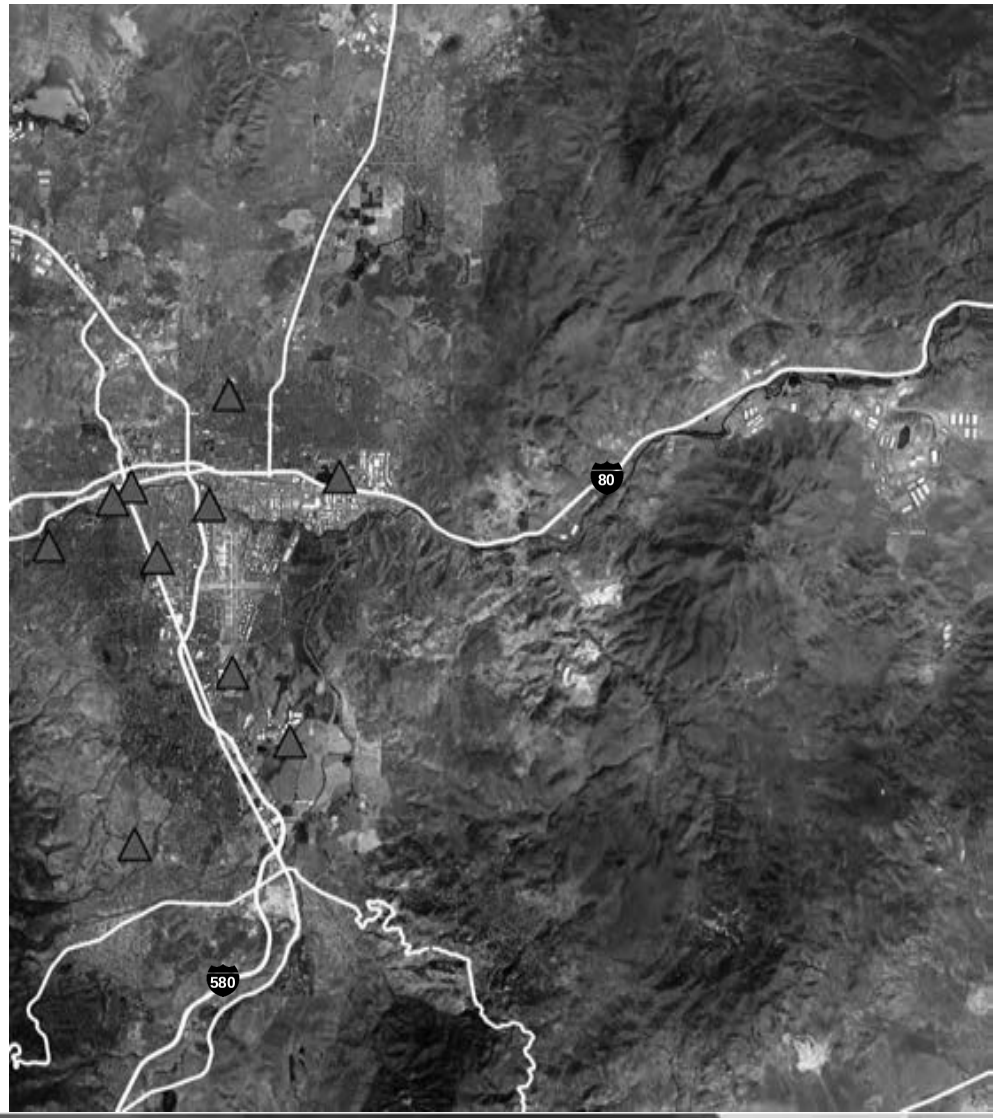


Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Completions

2022 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Privately Funded	9	$496.2 Million
▲ Publicly Funded	3	$401.1 Million
Total	12	$897.3 Million

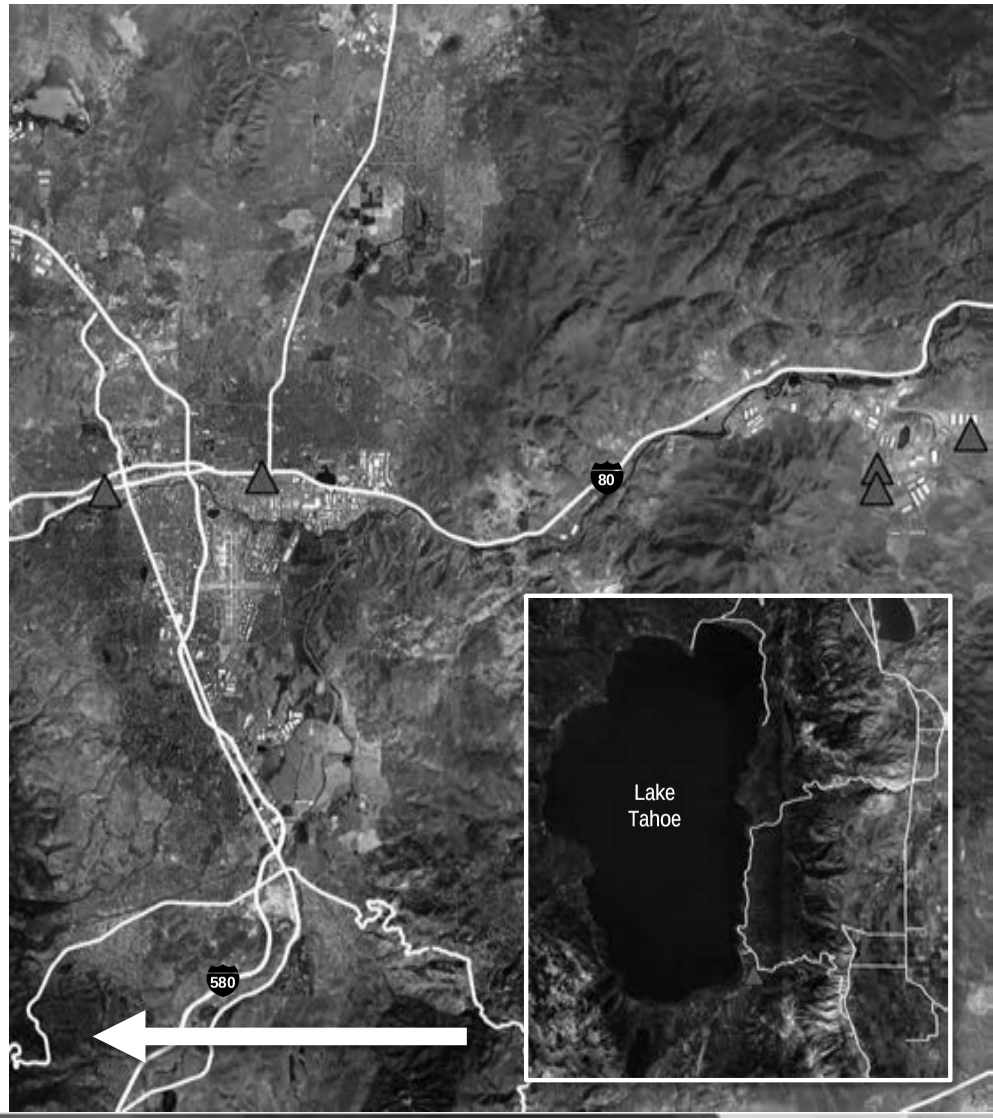


Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Completions

2023 | Notable Projects By Type

PROJECT TYPE	PROJECT COUNT	TOTAL VALUE
▲ Privately Funded	4	$6.1 Billion
▲ Publicly Funded	3	$107.8 Million
Total	7	$6.2 Billion



Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada

Completions | Privately Funded Projects

PROJECT	COST	STATUS	YEAR
Tesla Gigafactory	$6.0 B	Completed	2023
Reno Experience District	$600.0 M	Completed	2024
Google Data Center	$600.0 M	Completed	2021
J Resort (Sands Regency Remodel)	$400.0 M	Completed	2024
Northern Nevada Sierra Medical Center	$262.5 M	Completed	2022
Nanotech Energy Manufacturing Facility	$260.0 M	Completed	2024
Legends Bay Casino	$120.0 M	Completed	2022
The Dean Student Housing	$111.4 M	Completed	2024
Eldorado Resorts Master Plan	$100.0 M	Completed	2021
INOVA (Summit Club) Housing	$90.0 M	Completed	2019
Park Place Reno	$70.0 M	Completed	2020
The Club at Arrowcreek Renovations	$60.0 M	Completed	2022
Union Pacific Railroad Infrastructure Investment	$56.2 M	Completed	2023
Grand Sierra Resort Restaurant Improvements	$55.0 M	Completed	2024
Rancharrah	$50.0 M	Completed	2021
Silver Legacy Resort Casino Room Remodel	$47.0 M	Completed	2021
Canyon Flats - University of Nevada Reno	$37.0 M	Completed	2020

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada

Completions | Privately Funded Projects

PROJECT	COST	STATUS	YEAR
Reno Public Market	$34.0 M	Completed	November 2022
Identity Two Student Housing	$29.0 M	Completed	2020
Nugget Casino Resort in Sparks Renovation	$25.0 M	Completed	2021
Reno Neon Line - Arts	$25.0 M	Completed	2023
Stellar Aviation	$25.0 M	Completed	2024
Stellar Snacks New Facility	$23.4 M	Completed	2024
Northern Nevada Medical Center Expansion	$11.5 M	Completed	2020
Neon Line Renova Flats	$11.0 M	Completed	2020
Grand Sierra Resort Race and Sportsbook Renovations	$10.0 M	Completed	2022
Eden Towers	$5.2 M	Completed	2022
National Bowling Center Renovations	$4.5 M	Completed	2022
El Centro Rebrand of Joseph's Inn	$2.4 M	Completed	2021
Keystone Commons	DND	Completed	2021
Apple Data Center Expansion	DND	Completed	2019
Aqua Metals Innovation Center	DND	Completed	2023
Reno Sportsdome	DND	Completed	2022
Swift Sportsdome	DND	Completed	2022

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada

Completions | Privately Funded Projects

PROJECT	COST	STATUS	YEAR
The Marlette	DND	Completed	2024
Northern Nevada Health System Medical Office Building	DND	Completed	2024
The Edison	DND	Completed	2024
The Hyatt Place (The Summit)	DND	Completed	2024

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada

Completions | Publicly Funded Projects

PROJECT	COST	STATUS	YEAR
Procter R. Hug High School	$252.7 M	Completed	2022
Tahoe South Events Center	$100.0 M	Completed	2023
William O'Brien Middle School	$95.7 M	Completed	August 2022
UNR New Engineering Building	$92.0 M	Completed	2021
Virginia Street Project	$87.0 M	Completed	2021
Marce Herz Middle School	$85.0 M	Completed	2020
Swope Middle School Expansion	$52.7 M	Completed	2022
JWood Raw Elementary School	$46.6 M	Completed	2024
University Gateway Parking Complex	$40.6 M	Completed	2024
Hangar at Silver Springs Regional Airport	$5.0 M	Completed	2023
Arcadia Cold Storage	$2.8 M	Completed	2023
ReTRAC Plaza Beautification Phase I	$0.2 M	Completed	2021

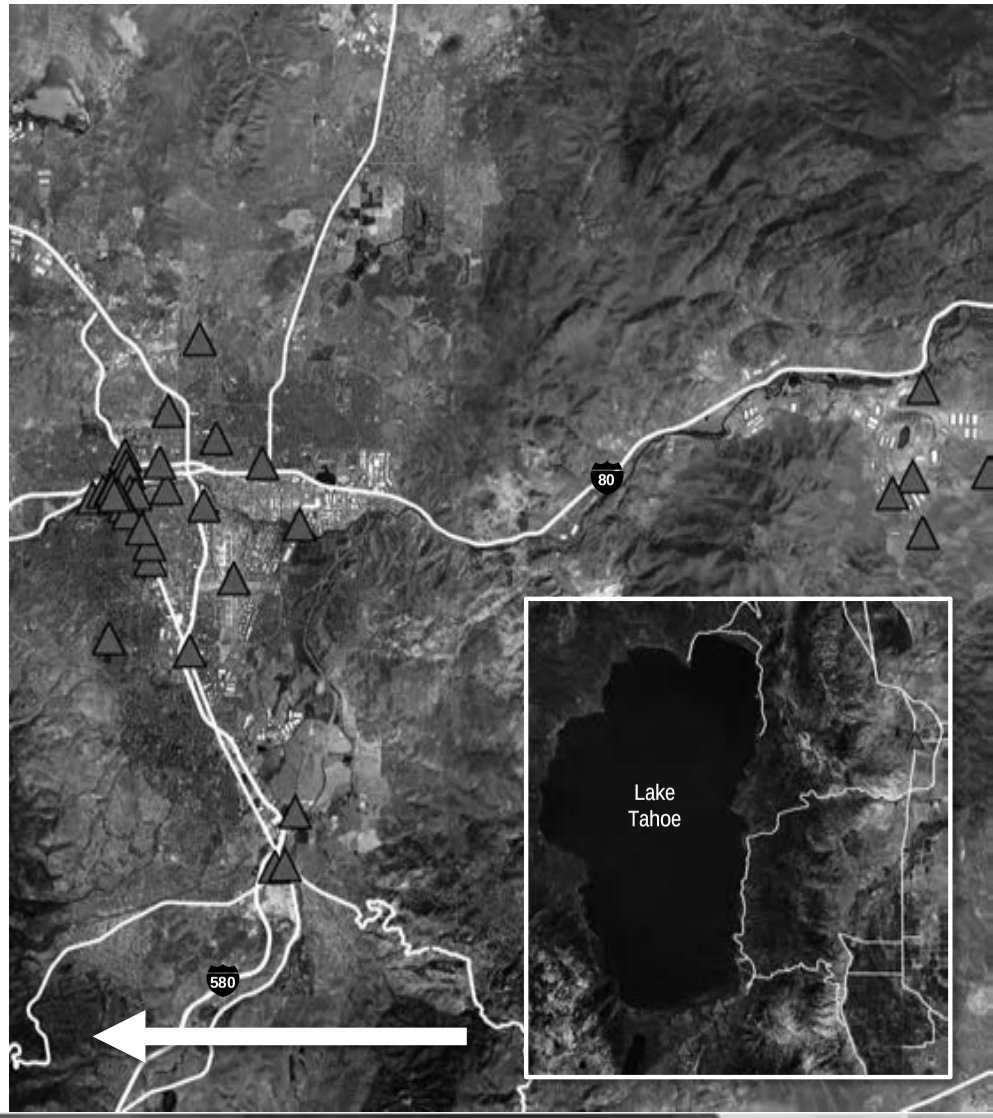
Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.


$9B+
UNDER CONSTRUCTION &
PLANNED INVESTMENTS

Northern Nevada Development Pipeline

Planned and UC Investments

PROJECT STATUS	TOTAL PROJECTS	TOTAL VALUE
Under Construction	24	$4.1 Billion
▲ Privately Funded	17	$2.4 Billion
▲ Publicly Funded	7	$1.7 Billion
Planned	17	$5.1 Billion
▲ Privately Funded	11	$4.6 Billion
▲ Publicly Funded	6	$427.3 Million
Total	41	$9.2 Billion



Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Investment Breakdown

Reno Area

Source: vegasdevmap.com.

Reno-Tahoe International Airport Expansion

$1.6 BILLION | EXPECTED COMPLETION 2025

Redwood Materials Battery Recycling Facility

$1.1 BILLION | EXPECTED COMPLETION 2025

Tesla Gigafactory Expansion

$3.6 BILLION | PLANNED

Grand Sierra Resort Expansion and Renovations

$1.0 BILLION | PLANNED

Northern Nevada Development Pipeline

Under Construction | Privately Funded Projects

PROJECT	COST	STATUS	EST. COMPLETION
Redwood Materials Battery Recycling Facility	$1.1 B	Under Construction	2025
Novva Data Center - Tahoe Reno	$500.0 M	Under Construction	2024
580 South Industrial Project	$155.0 M	Under Construction	2025
Horse Oasis	$150.0 M	Under Construction	TBD
661 Lake Student Housing	$131.0 M	Under Construction	TBD
The Ridge at Sun Valley	$128.3 M	Under Construction	2025
Reno City Center	$100.0 M	Under Construction	2024
Kimpton Hotel	$100.0 M	Under Construction	2025
Nevada Museum of Art Expansion	$60.0 M	Under Construction	2025
960 S. Virginia St. - Marmot Properties	$3.0 M	Under Construction	TBD
Switch Citadel	DND	Under Construction	2024
Skypointe	DND	Under Construction	2024
Ballpark Apartments	DND	Under Construction	2024
Repvblik Affordable Housing Apartments	DND	Under Construction	2024
Aqua Metals Battery Recycling Facility	DND	Under Construction	2024
121 Vesta Dr. - Marmot Properties	DND	Under Construction	TBD
245 North Arlington	DND	Under Construction	TBD

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Development Pipeline

Under Construction | Publicly Funded Projects

PROJECT	COST	STATUS	EST. COMPLETION
Reno-Tahoe International Airport Expansion	$1.6 B	Under Construction	2025
Reno Public Safety Center	$54.0 M	Under Construction	2024
Oddie Wells Project	$51.0 M	Under Construction	2024
Renovations to Nevada Legislative Building	$15.0 M	Under Construction	2024
Gen Den	$2.4 M	Under Construction	January 2024
Dick Scott Manor	DND	Under Construction	2024
Railyard Flats	DND	Under Construction	2024

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Development Pipeline

Planned | Privately Funded Projects

PROJECT	COST	STATUS	EST. COMPLETION
Tesla Gigafactory Expansion	$3.6 B	Planned	TBD
Grand Sierra Resort Expansions and Renovations	$1.0 B	Planned	2033
Jacobs Entertainment Affordable Housing Development	$20.0 M	Planned	TBD
Dave & Busters	$5.8 M	Planned	TBD
Neon Line Mixed Use 1	DND	Planned	TBD
Neon Line Hotel	DND	Planned	TBD
Neon Line Residential	DND	Planned	TBD
Neon Line Office	DND	Planned	TBD
Lyon Living Condos - Lakeridge	DND	Planned	TBD
101 N Virginia (Woolworth's)	DND	Planned	TBD
Downtown Damonte	DND	Planned	2025

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

Northern Nevada Development Pipeline

Planned | Publicly Funded Projects

PROJECT	COST	STATUS	EST. COMPLETION
Debbie Smith CTE Academy High School	$125.0 M	Planned	TBD
UNR New College of Business Building	$117.7 M	Planned	TBD
UNR Life Sciences Building	$94.1 M	Planned	TBD
South Lake Tahoe Aquatics Center	$67.9 M	Planned	2026
Sugar Pine Village	$19.6 M	Planned	2024
Truckee River Improvements	$3.0 M	Planned	TBD

Source: vegasdevmap.com. Note: Not all projects disclose capital costs. Values are estimates.

NVEnergy

ECONOMIC OVERVIEW & DEVELOPMENT PIPELINE

2024

APPLIED ANALYSIS

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APPLIED ANALYSIS

Memorandum

From: Jeremy Aguero, Applied Analysis
Date: May 28, 2024
Subject: NV Energy Integrated Resource Plan 2024 | Increasing Power Demand in the United States and Nevada

Applied Analysis ("AA") has prepared this memorandum summarizing preliminary research into the key drivers of energy consumption in the United States and Nevada, as well as how Nevada has already adapted and is further preparing in response to energy demand associated with the state's rapid economic growth.

Digital Demands Fuel Growth in Energy Use

Energy demands are surging due to a confluence of economic, technological and societal factors, shifting the sector's landscape both in Nevada and nationwide. This white paper explores the trend's underlying drivers, assesses their implications and outlines key considerations to addressing associated challenges.

Rapid technological advancement is a primary catalyst to the increased demand. Digital technologies have revolutionized every aspect of our lives, from how we work and communicate, to how we consume entertainment and conduct commerce. This proliferation has sent current energy needs soaring above previous forecasts.

In the United States, electrical grid planners are now considering new growth trajectories, leading them to double their five-year load growth projection to 4.7 percent.[1] In 2000, the International Energy Agency (IEA) predicted worldwide energy consumption would reach 382 exajoules in 2020, a number that was surpassed by 2010.[2] Globally, previous estimates put some 130 million electrical vehicle (EVs) on roadways by 2030,[3] but more recent data suggest the figure will be closer to 250 million by that time.[4] The International Telecommunication Union approximates 5.4 billion people used the Internet in 2023, more than double those logging on a decade ago.[5] Simply put, our 21st Century digital economy is simply growing faster than any one anticipated.

As recently as 2022, electricity comprised about 20.1 percent of the world's energy consumption, according to the IEA. Demand rose by 2.4 percent in 2022 and another 2.2 percent in 2023; it is projected to increase by an average 3.4 percent annually through 2026.[6] National electricity consumption grew at a compound annual growth rate of 0.61 percent during the past 10 years, outpacing the population growth of 0.56 percent, despite advances in efficiency.[7] The flourishing use of AI applications, and the data centers that make them possible, is poised to ramp up additional demand abroad and at home, as the technology requires immense computing power.

[1] The Era of Flat Power Demand is Over, GridStrategies (at https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf)
[2] World Energy Outlook 2000, IEA (at https://iea.blob.core.windows.net/assets/ecbb1607-2c53-4b72-b2c2-bdd2d2fedf48/WorldEnergyOutlook2000.pdf); World Energy Outlook 2023, IEA (at https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf)
[3] Global EV Outlook 2018, IEA (at https://iea.blob.core.windows.net/assets/387e4191-acab-4665-9742-073499e3fa9d/Global_EV_Outlook_2018.pdf)
[4] Electric Vehicle Fleet Set to Hit 100 Million by 2026, but Stronger Push Needed to Stay on Track for Net Zero, BloombergNEF (at https://about.bnef.com/blog/electric-vehicle-fleet-set-to-hit-100-million-by-2026-but-stronger-push-needed-to-stay-on-track-for-net-zero/#:~:text=By%202030%2C%20there%20are%20244,and%201.1%20billion%20by%202040.&text=Oil%20demand%20from%20road%20transpor.)
[5] Statistics, International Telecommunication Union (at https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx)
[6] Electricity 2024, IEA (at https://www.iea.org/reports/electricity-2024/executive-summary)
[7] U.S. Energy Information Administration (at https://www.eia.gov/electricity/data/state/xls/861/HS861 2010-.xlsx)

In the United States, CBRE reports the market supply of data centers grew 26 percent over the past year, presenting a significant energy challenge for many states.[8] Some 2,700 data centers across the nation used more than 4 percent of all electricity in 2022, a share that is expected to increase to 6 percent by 2026, according to IEA.[9] Data center power consumption is forecast to grow by about 10 percent each year through 2030, effectively doubling demand from this sector.[10] Goldman Sachs research further predicts the global power demand from data centers will more than double by 2030, a surge that will also be a major accelerator of domestic electricity demand.[11] Industry stakeholders and public officials are actively working together to adapt infrastructure to handle the added stress of this new economic reality.

Nevada's economy is rapidly evolving due to the influx of major data centers from tech giants like Tesla, Switch and Google. The arrival of new projects such as the PowerHouse Data Centers in Reno exemplifies the attractiveness of the state's strong infrastructure and business friendly tax system. However, these data centers have a significant impact on Nevada's energy profile. The state, which primarily relies on natural gas for electricity, is adapting its infrastructure to accommodate the high demands of these power-intensive facilities. This includes substantial investments in renewable energy projects, such as the $1.3 billion Gemini solar project, which aims to provide cleaner energy options to support the growing needs of data centers.

Overall, the expansion of data centers in Nevada presents both opportunities and challenges. It drives technological investment and economic growth, but also creates a need for increased electricity supply and sustainable energy solutions. The state's approach focuses on balancing these demands with environmental considerations and infrastructure development to support continued innovation and growth.

Nevada Mirrors National Trends

Nevada's electricity consumption has experienced a similar trajectory to that of the U.S. overall, with a compound annual growth rate of 1.1 percent over the same period, propelled primarily by the state's economic development and sustained population influx.[12] During the past decade, Nevada's population has grown by 15.0 percent, far outpacing the national average of 5.7 percent.[13] This population growth, driven by factors such as job opportunities, affordable living costs and a favorable business environment, has resulted in heightened demand for electricity to power homes, businesses and infrastructure.

Nevada's rapid economic growth has been fueled by a diverse range of industries, each adding demand for electricity. The state's construction sector has experienced robust expansion, fueled by infrastructure development and residential and commercial building projects. Construction activities, including the operation of heavy machinery and construction sites, require significant energy inputs, further contributing to electricity demand. Additionally, Nevada's expanding health care industry, characterized by major hospital systems and medical facilities, relies heavily on electricity to power medical equipment, lighting and climate control systems. Furthermore, the state's agricultural sector, although relatively small compared to other industries, still contributes to electricity demand through irrigation systems, climate-controlled greenhouses and processing facilities. The state's tech industry alone had a $9.2 billion economic impact and supports some 54,000 jobs, illustrating the significant impact of business expansion on energy consumption.[14]

[8] North America Data Center Trends H2 2023, CBRE (at https://www.cbre.com/insights/reports/north-america-data-center-trends-h2-2023)
[9] Amid explosive demand, America is running out of power, Washington Post (at https://www.washingtonpost.com/business/2024/03/07/ai-data-centers-power/)
[10] Five Trends Driving The Booming Data Center Economy in 2024 [And Why Investors Are Taking Notice], Forbes (at https://www.forbes.com/sites/forbestechcouncil/2024/01/22/five-trends-driving-the-booming-data-center-economy-in-2024-and-why-investors-are-taking-notice/?sh=16610ad76fa5)
[11] AI, data centers and the coming US power demand surge (at https://www.goldmansachs.com/intelligence/pages/gs-research/generational-growth-ai-data-centers-and-the-coming-us-power-surge/report.pdf)
[12] U.S. Energy Information Administration (at https://www.eia.gov/electricity/data/state/xls/861/HS861 2010-.xlsx)
[13] Resident Population in Nevada, FRED (at https://fred.stlouisfed.org/series/NVPOP)
[14] State of the Tech Workforce 2024, CompTIA (at https://comptiacdn.azureedge.net/webcontent/docs/default-source/research-reports/comptia-state-of-the-tech-workforce-2024.pdf?sfvrsn=a8aa5246_2)

Nevada's economic development strategy, outlined in the state's five-year statewide economic development plan, emphasizes growth in key sectors including technology, advanced manufacturing and renewable energy.[15] This strategic focus is driven by the recognition that these industries are pivotal to the state's future economic resilience and diversification. Not only does the strategy aim to position Nevada as a global leader in the complete cycle of clean energy innovation, but it also identifies information technology, transportation and logistics, and natural resources and technologies as additional critical sectors for development.

To achieve these ambitious goals, the Nevada Governor's Office of Economic Development (GOED) has been proactive in leveraging various initiatives. For instance, in 2023, GOED approved significant tax abatements for 25 companies, which are projected to create 2,024 jobs within two years and result in $4.0 billion in capital investments.[16] These developments will generate more than $1.0 billion in new net tax revenues for the state over the next decade, supporting services from schools to long-term care to the construction of roads and highways. Furthermore, these efforts align with the broader vision to exceed growing demands for electricity, underscoring the need for strategic planning in energy infrastructure to support sustained economic growth.

Shifts Toward Green Energy

Among the factors reshaping the energy landscape is the electrification of transportation. BloombergNEF forecasts that global EV sales will surpass internal combustion engine vehicles by 2035.[17] Moreover, EV charging infrastructure in the United States is expected to grow from 4 million current charging points to as many as 35 million by 2030, according to PricewaterhouseCoopers.[18] EV adoption is already accelerating in Nevada, spurred by favorable state policies, declining battery costs, increasing consumer awareness and incentives for ownership. EVs are exempt from the state's vehicle emission testing requirements, and new hybrid-electric vehicles are exempt for five years. Importantly, Nevada continues to encourage innovation, attracting projects like the Vegas Loop. At buildout, the underground transportation system will use electric Tesla vehicles to move as many as 90,000 passengers-per-hour through an expansive network of tunnels and stations to locations around the Las Vegas Strip.[19]

Nevada has also championed autonomous vehicle (AV) development. In 2011, it became the first state to legalize self-driving vehicles.[20] This not only paves the way for a market in which individuals can purchase AVs, but also for autonomous fleets of vehicles to serve the logistics and transportation industries. The first self-driving semi-truck licensed to operate on public roadways piloted the highways here in 2015.[21] The advancement of AV technology will likely bring increased investment in EVs, as they provide an optimal platform for integration with autonomous technology.

Moreover, Nevada's transition toward renewable energy, including solar and wind, has significantly impacted the state's electricity demand dynamics. Renewable energy generation is inherently intermittent, varying with weather conditions and time of day, necessitating flexible grid infrastructure and energy storage solutions to ensure reliability. Nevada's abundance of sunlight has led to the expansion of solar farms, while distributed generation has led to a substantial increase in electricity production from renewable sources. The state currently boasts an installed capacity of around 6,382 megawatts (MW) of solar power, and this number is expected to grow by another 6,945 MW over the next five years.[22] This burgeoning

[15] Realizing Nevada's Electric, Innovative, and Connected Future, GOED (at https://goed.nv.gov/wp-content/uploads/2024/02/Statewide-Plan-Water-Health-Executive-Summary-1.pdf)
[16] Quarterly Performance Report, GOED (at https://goed.nv.gov/wp-content/uploads/2024/03/6.-GOED-Performance-Metrics-Mar-2024.pdf)
[17] Electric Vehicle Outlook, BloombergNEF (at https://assets.bbhub.io/professional/sites/24/2431510_BNEFElectricVehicleOutlook2023_ExecSummary.pdf)
[18] America's coast-to-coast EV-charging network: Where – and how – it could roll out, PwC (at https://www.pwc.com/us/en/industries/industrial-products/library/american-ev-charging-network-rollout.html#:~:text=Indeed%2C%20a%20recent%20PwC%20analysis,the%20same%20period%20(including%20public%2C)
[19] Vegas Loop, Boring Company (at https://www.boringcompany.com/vegas-loop)
[20] Assembly Bill 511 (2011), Nevada Legislature (at https://www.leg.state.nv.us/Session/76th2011/Bills/AB/AB511_EN.pdf)
[21] Daimler puts first self-driving semi-truck on road, CBS (at https://www.cbsnews.com/news/daimler-puts-first-self-driving-semi-truck-on-road/)
[22] Solar State By State, SEIA (at https://www.seia.org/state-solar-policy/nevada-solar)

renewable energy capacity has further influenced electricity demands, necessitating strategic planning to balance supply and demand while maximizing the benefits of renewable energy integration.

Nevada Power Demands Shaped by New Residents, Attractions

The COVID-19 pandemic has also reshaped the state's employment landscape, increasing the prevalence of remote work. According to the data from the U.S. Census Bureau, an estimated 11.9 percent of Nevada's workforce worked from home as recently as 2022, relying on electronic devices and home office setups to fulfill their job responsibilities.[23] This shift toward remote work has implications for electricity demand, as residential energy consumption surges during typical working hours. Additionally, Nevada has seen droves of new residents relocating from neighboring states like California, drawn by the benefits of living in a different environment than where they work, underscoring the need to accommodate this trend in energy planning and infrastructure development.

The tourism sector remains a cornerstone of Nevada's economy, significantly impacting electricity demand. Las Vegas is renowned for its vibrant entertainment scene and world-class resorts, which consume vast amounts of electricity to power dazzling lights, extensive air-conditioning systems and myriad attractions. Major event centers such as Allegiant Stadium, T-Mobile Arena and the newly constructed Sphere entertainment venue are architectural marvels equipped with advanced technology that require substantial energy inputs.

Allegiant Stadium, home to the Las Vegas Raiders, features a massive retractable NFL field and an expansive transparent roof, both of which are energy intensive. T-Mobile Arena, which hosts the NHL's Vegas Golden Knights, includes state-of-the-art HVAC systems and lighting designed to enhance the spectator experience while optimizing energy use. The Sphere emphasizes next-generation sound and light experiences, including 1.2 million LED fixtures, which are expected to set new standards for energy consumption in performance spaces. To be clear, innovative investments like these driving opportunity in Nevada, but their pace and intensity – combined with other investments citied through this report – are expanding at a remarkable pace and are driving unpreceded demand for electricity.

As tourism rebounds from the pandemic-induced downturn, new hotels, and the venues that motivate visitors to fill them, are already proving pivotal in drawing visitors back to the city. The expected increase in events and attendees will naturally lead to a further surge in electricity demand from hotels, casinos, convention centers and these high-profile event centers.

State Power Policies and Programs

Nevada's commitment to a sustainable energy future is prominently reflected in its legislative framework and strategic initiatives. The state's ambitious clean energy goals are articulated in the Renewable Portfolio Standard (RPS)[24] and other supporting legislation. These laws mandate a progressive shift, targeting 50 percent renewable energy by 2030 and aiming for 100 percent carbon-free electricity by 2050. This transition involves not only escalating investments in renewable energy infrastructure but also strategically phasing out older, less efficient fossil fuel-based energy facilities as more efficient and cleaner alternatives come online. Respecting that efforts have also been made to extend the life of existing facilities and peaking capabilities, incremental capacity has largely favored renewable energy alternatives.

Nevada's abundant natural resources, such as high solar irradiance and significant geothermal potential, make it an ideal location for renewable energy investments. The development of large-scale solar farms and the expansion of geothermal power plants illustrate how the state is capitalizing on these resources. However, the intermittent nature of solar and wind energy requires the development of robust energy storage solutions and grid modernization to ensure a continuous and reliable power supply.

By transitioning from older energy facilities to modern, cleaner technologies, Nevada aims to meet its legislative goals and reduce its environmental footprint, thereby enhancing air quality and contributing to global efforts against climate change. This strategic approach supports environmental sustainability and positions Nevada as a leader in the green energy

[23] IPUMS USA, University of Minnesota and Applied Analysis
[24] Renewable Portfolio Standard, PUCN (at https://puc.nv.gov/Renewable_Energy/Portfolio_Standard/)

economy, promising long-term economic benefits and job creation in emerging technology sectors. Nonetheless, the state faces the ongoing challenge of balancing energy production with the need for reliable and sufficient power to meet the demands of its population and economy.

As businesses expand their operations and invest in technological innovations, the demand for electricity continues to grow, necessitating strategic investments in energy infrastructure and modernization to meet evolving needs. To meet these challenges, Nevada, like other states, has prioritized upgrades to its electrical grid, smart technologies and energy storage through various initiatives and investments. For instance, public utility NV Energy is modernizing its grid infrastructure and accommodating renewable energy integration through the Greenlink Nevada project.[25]

Furthermore, Nevada has pursued initiatives to promote energy efficiency across residential, commercial and industrial sectors. Similar to programs in California and New York, Nevada offers incentives through initiatives like the Nevada Energy Efficient Appliance Rebate Program.[26]
Additionally, companies like NV Energy have implemented demand response programs to reduce electricity consumption during peak periods, enhancing grid stability.

In exploring emerging technologies, Nevada has begun debating technologies ranging from hydrogen fuel cells to advanced nuclear reactors. While specific initiatives may vary and some may prove politically or practically untenable, the state has demonstrated an increasing willingness to research and development in innovative areas that will leave no stone unturned as it seeks to diversify its energy portfolio and reduce greenhouse gas emissions. Additionally, the state continues to invest in regulatory frameworks to facilitate the deployment of advanced energy technologies.

In conclusion, Nevada's dynamic economic landscape, coupled with demographic shifts and changing work patterns, has contributed to an unprecedented surge in electricity demand. To effectively manage this challenge and ensure a reliable, sustainable energy future, Nevada must prioritize investments in grid modernization, energy efficiency initiatives and diversified energy sources. By embracing innovation and collaboration among stakeholders, Nevada has the opportunity to harness the power surge to drive economic growth, enhance quality of life and propel the state toward a brighter tomorrow. Missing this opportunity is expected to have an equal and opposite effect.

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[25] Greenlink Nevada, NV Energy (at https://www.nvenergy.com/cleanenergy/greenlink)
[26] Home Energy Rebates (Inflation Reduction Act), Nevada Governor's Office of Energy (at https://energy.nv.gov/Resources/Federal_Funding_Opportunities/IRA-Rebates/)

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