Technical Memorandum

RCGeconomics

To: Mike Kazmierski
President/CEO
Economic Development Authority of Western Nevada ("EDAWN")

From: John Restrepo & Hubert Hensen
RCG Economics ("RCG")

Date: January 29, 2019

RE: *Northern Nevada Economic Planning Indicators Committee ("EPIC") Report Update*

The purpose of this technical memorandum ("TM") is to update the original five-county EPIC forecast ("Original Study") with the latest historical (actual) data, as well as to create a new five-year forecast.

The forecasts herein cover the same five-county region ("Study Area") as in the Original Study:

1. Douglas County
2. Lyon County
3. Storey County
4. Washoe County
5. Carson City

These forecasts cover the same three indicators as in the original study:

1. Population
2. Employment
3. Households

The five-year forecast period described herein in this TM is 2019 – 2023 ("Study Period"). This TM relies on third-party forecasts, adjustments to third-party forecasts and an in-house forecast.

Data & Analysis

First, RCG collected data from five sources:

- Woods & Poole ("W&P")
- Nevada State Demographer ("NSD")/Bureau of Economic Analysis ("BEA")
- IHS Global Insights ("IHS")
- Truckee Meadows Water Authority ("TMWA")
- Economic Modeling Specialists Intl. ("EMSI")

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These sources formed the basis of our forecast. Certain sources provided forecasts for the Study Area as a whole, while others provided forecasts at the county level, which RCG then summed or scaled up.

Woods & Poole

We collected data from the W&P 2018 data set for all five counties and for all three indicators. These data included historical data as well as forecasts over the Study Period and beyond. For the Study Area, we summed estimates for all five counties for each indicator.

Nevada State Demographer/Bureau of Economic Analysis

We also collected population data from NSD and employment data from the BEA. NSD models are based on historical data from the BEA. Accordingly, these two sources are essentially one and the same. The number of households was derived from the population estimates.

For the population data, RCG used the sum of the county-level estimates, which included forecasted estimates over the Study Period.

The household estimates herein are based on the county-level population estimates. We divided the population in each year for each county by that county's persons per household ratio, as reported by the U.S. Census for 2013 – 2017. We then summed the county-level household estimates, providing weighted values for Study Area households.

For employment, RCG obtained historical data from the BEA website for each county from 2001 – 2017. We used these data at the behest of the NSD. BEA data are used in the NSD model and are therefore identical to NSD data for historical estimates. We summed these values to obtain historical estimates for the Study Area. For the forecast, RCG input the Study Area-level employment from 2001 to 2017 into an Autoregressive Integrated Moving Average with Explanatory Variable ("ARIMAX") model.[1] This model forecasts an indicator based on its relationship with other indicators. In this case, RCG used Study Area population as an explanatory variable.

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[1] RCG applied an ARIMAX model of order (1, 1, 0) with population as an explanatory variable. Based on testing of the data and the model residuals, we determined that the data were stationary and the output residuals were not auto-correlated and were normally distributed.

IHS Global Insights

RCG was only provided IHS data for Washoe County from TMRPA. These were for population, employment and households. However, the employment series was for payroll employment, which does not include all types of workers (e.g., contract employees, freelancers) as do the total employment figures employed by W&P, NSD, BEA, TMWA, EMSI and in the original EPIC study. To account for this, we used the adjustment method in the Washoe County Consensus Forecast, as suggested by the Truckee Meadows Regional Planning Agency. We then multiplied the payroll employment figures by 1.44, which is the average difference as a multiple between these figures. With this, it was possible to convert all the IHS estimates to the Study Area-level.

To create a Study Area population estimate, RCG multiplied the IHS Washoe County population estimate by the average ratio of the Washoe population-to-Study Area population for W&P and the NSD in each year.

RCG based the household estimates on these calculated population estimates. We divided the Study Area population by the average of the population-to-household ratios, based on the W&P and NSD Study Area-level population-to-households estimates.

There are no county-level employment projections from the NSD. This means that we could not use NSD employment data to scale county-level IHS employment data to the Study Area. Accordingly, rather than applying the average of the W&P and NSD population-to-employment ratios in each year to population, we calculated the average historical (2001 – 2017) BEA/NSD employment-to-population ratio and averaged that with the average of W&P employment-to-population ratio each year. We then applied this modified average population-to-employment ratio to population to calculate employment.

Truckee Meadows Water Authority

TMWA provided population projections at the Study Area level based on data from the U.S. Census and NSD.

The TMWA household estimate was calculated the same way as the IHS household estimate. RCG divided the Study Area population estimates by the average of the population-to-household ratios, based on the W&P and NSD Study Area-level population-to-households estimates.

The employment estimate was calculated similarly to the household estimate. We multiplied the Study Area population estimates by the average of the employment-to-population ratios, based on the W&P and NSD Study Area-level employment-to-population estimates.

Economic Modeling Specialists Intl.

RCG used data from EMSI for the Study Area on population and employment. These data were provided by the Governor's Office of Economic Development. These data also included historical data and forecasts over the Study Period. For households, we used the same method of applying the average population-to-household ratio as used for TMWA households.

Adjustment to 2018

After the above steps were completed, RCG adjusted the 2018 growth rate for each of the five sources/series. We made this adjustment after doing additional research and discussions with various parties, including Bob Potts, Research Director for the Governor's Office of Economic Development. There are two main problems that necessitate changes to the 2018 data.

First, for most of the five series used in this forecast, the 2018 data are based on projections developed by each of the sources, not officially-reported government data. This is because annual data are usually produced after a year ends and include some lag time.

Second, one data set, EMSI, does include early 2018 data, but that data has issues. The EMSI data take into account data for Q1, 2018 and extrapolate them to estimate totals for the year. However, based on information from the Nevada Department of Employment, Training and Rehabilitation ("DETR"), this methodology overemphasizes the normal seasonal reductions between the 4th quarter and 1st quarter of the year, when holiday-hiring employment ends.

To correct the shortcomings in this data set for 2018, we adjusted the 2018 job growth rate in each series based on job growth data from DETR's monthly employment series, the Current Employment Statistics ("CES"). The CES showed payroll job growth of approximately 4.2 percent for Washoe, Storey and Carson City counties in 2018—CES does not cover the other two counties in the Study Area. However, we also noted that total jobs over the last five years have grown slower than the payroll jobs reported in the CES. Based on this difference, we applied a growth rate of 3.5 percent to the 2017 employment data herein for each source to obtain their adjusted 2018 job estimates. These changes are reflected in the relevant charts

and tables at the end of this TM. Then we used the job growth rates for 2019 – 2023 from the forecasts produced above to generate the new adjusted forecasts based on the revised 2018 employment estimates.

With new employment estimates for 2018, it was important to ensure that they aligned with the population and household estimates. Population estimates also lag and final 2018 population estimates have not been included in all of the five data sources used in this analysis. The 2018 population estimates from the U.S. Census Bureau have been out for only one month and the official 2018 NSD estimates are not yet released. Therefore, we also adjusted the population growth in 2018 to align better with the adjusted employment growth in 2018. Within each source, we compared the Study Area's population growth over the prior three years to employment growth over those three years to produce a ratio of recent population growth-to-employment growth. We then applied that ratio to 2018's 3.5 percent employment growth for each source.

For households, we first calculated the population and household growth rates from 2017 to 2018 in the pre-adjustment results. Based on these growth rates, we calculated the resulting household growth-to-population growth ratio. Then, we applied this ratio to the adjusted population growth rate in 2018 to produce the adjusted household growth rate for 2018. This kept the relationship between the three indicators consistent and reasonable.

Adjusting each of the five sources in 2018 as described above and then applying the previously-developed growth rates for 2019 – 2023 to those 2018 estimates, RCG produced the final values for each indicator for each source.

Consensus

RCG developed "Consensus" projections for the three indicators for each source after the adjustments discussed above. The Consensus estimates are the averages of each source, post-adjustment, at the Study Area-level for each indicator. However, RCG also wanted to account for an external growth factor that would not be likely included in all the sources' forecasts of each indicator. That factor is the effect of economic development efforts in the region. These efforts can point to several job creation and business attraction/expansion successes over the last decade, with the most conspicuous being the Tesla Motors Gigafactory.

To include these effects, we received information from EDAWN regarding expected job gains through development efforts. EDAWN's latest estimates equate to approximately 2,500 jobs per year during the Study Period. Therefore, we added these prospective "pipeline" jobs to the Consensus employment figures. Then, using the Consensus historical population-to-employment and household-to-employment ratios

discussed above. RCG developed the final set of population and households, based on these additional job estimates. As noted, this step resulted in the creation of the final Consensus estimates presented herein.

Results

The final results—the average of the five sources plus EDAWN pipeline jobs —can be seen in Table 1. The data show that the Study Area population is projected to increase by 8.6 percent over the course of the Study Period. As shown at the bottom of Table 1, employment is expected to rise by 12.7 percent, while households are projected to grow by 8.8 percent during the five years. These percent changes are for the five-year Study Period as a whole; they are NOT annual. By the end of the Study Period, RCG projects that the Study Area's population, employment and households to grow by 54,470 persons, 51,585 jobs and 22,559 households (see Figure 1).

On an annual basis, RCG forecasts growth in population to start out at 1.9 percent in 2019 and slow to 1.5 percent by 2023. For employment, that growth is expected to change from 3.1 percent in 2019 to 1.8 percent in 2023. For households, forecasted growth starts at 2.0 percent and moderates to 1.5 percent by 2023 (see Table 2 & Figure 2).

In terms of annual absolute growth, RCG is projecting the Study Area's population to rise by 11,954 persons in 2019, dropping to 10,139 new persons by 2023. For employment, we are forecasting 12,753 new jobs in 2019 with growth moderating to 8,087 new jobs in 2023. Finally, for households, we expect growth of 5,141 households in 2019 declining to 3,983 new households (see Table 3 & Figure 3) by 2023.

RCG's analysis is illustrated in the tables and charts below. Table A with county-level forecasts is available in the *Appendix*.

Table 1: Study Area Consensus Forecast: 2019 – 2023

Year	Consensus		
	Population	Employment	Households
2001	490,300	339,634	195,640
2002	502,393	338,810	200,312
2003	517,893	346,037	207,181
2004	534,424	360,666	213,067
2005	551,698	374,266	219,777
2006	566,456	385,242	225,129
2007	577,438	390,938	229,573
2008	583,694	378,594	231,615
2009	580,602	350,736	229,427
2010	581,597	340,978	229,929
2011	583,440	341,737	232,404
2012	586,938	341,784	234,802
2013	591,016	351,013	237,482
2014	597,355	358,253	239,591
2015	604,224	368,592	242,534
2016	613,188	381,166	246,904
2017	622,477	392,871	251,335
2018	632,267	406,621	255,925
2019	*644,221*	*419,375*	*261,066*
2020	*655,418*	*430,928*	*265,809*
2021	*666,263*	*440,926*	*270,336*
2022	*676,598*	*450,119*	*274,500*
2023	*686,737*	*458,206*	*278,484*
5-Yr % Chg.	8.6%	12.7%	8.8%
5-Yr Chg.	54,470	51,585	22,559

Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN

Table 2: Study Area Consensus Forecast: Annual Percent Change: 2019 – 2023

| Year | Consensus | | |
	Population	Employment	Households
2002	2.5%	-0.2%	2.4%
2003	3.1%	2.1%	3.4%
2004	3.2%	4.2%	2.8%
2005	3.2%	3.8%	3.1%
2006	2.7%	2.9%	2.4%
2007	1.9%	1.5%	2.0%
2008	1.1%	-3.2%	0.9%
2009	-0.5%	-7.4%	-0.9%
2010	0.2%	-2.8%	0.2%
2011	0.3%	0.2%	1.1%
2012	0.6%	0.0%	1.0%
2013	0.7%	2.7%	1.1%
2014	1.1%	2.1%	0.9%
2015	1.1%	2.9%	1.2%
2016	1.5%	3.4%	1.8%
2017	1.5%	3.1%	1.8%
2018	1.6%	3.5%	1.8%
2019	*1.9%*	*3.1%*	*2.0%*
2020	*1.7%*	*2.8%*	*1.8%*
2021	*1.7%*	*2.3%*	*1.7%*
2022	*1.6%*	*2.1%*	*1.5%*
2023	*1.5%*	*1.8%*	*1.5%*

Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN

Table 3: Study Area Consensus Forecast: Annual Absolute Change: 2019 – 2023

Year	Consensus		
	Population	Employment	Households
2002	12,094	-824	4,672
2003	15,500	7,227	6,869
2004	16,531	14,629	5,886
2005	17,273	13,599	6,710
2006	14,758	10,976	5,352
2007	10,982	5,696	4,444
2008	6,255	-12,344	2,042
2009	-3,092	-27,858	-2,188
2010	995	-9,758	503
2011	1,843	759	2,475
2012	3,498	47	2,398
2013	4,078	9,229	2,680
2014	6,339	7,240	2,109
2015	6,869	10,339	2,943
2016	8,964	12,574	4,370
2017	9,289	11,704	4,432
2018	9,791	13,750	4,589
2019	*11,954*	*12,753*	*5,141*
2020	*11,197*	*11,553*	*4,744*
2021	*10,844*	*9,998*	*4,527*
2022	*10,335*	*9,193*	*4,164*
2023	*10,139*	*8,087*	*3,983*

Note: Forecast years in shaded area.
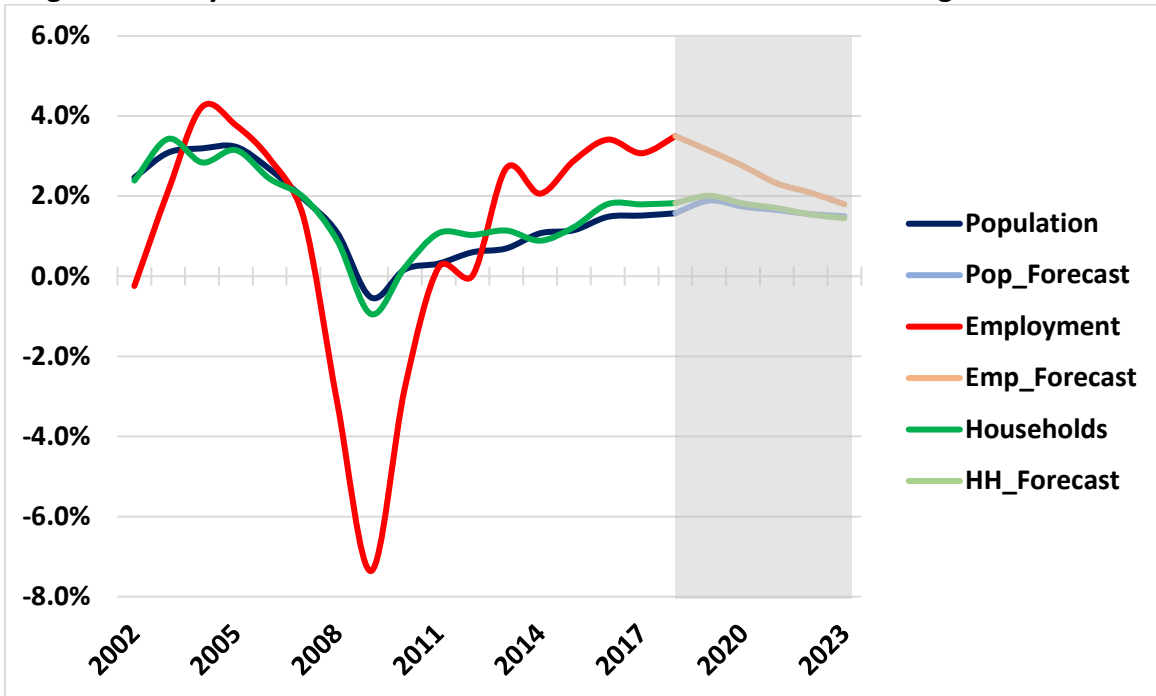*Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN*

Figure 1: Study Area Total Consensus Historical Estimates & Forecasts: 2019 – 2023
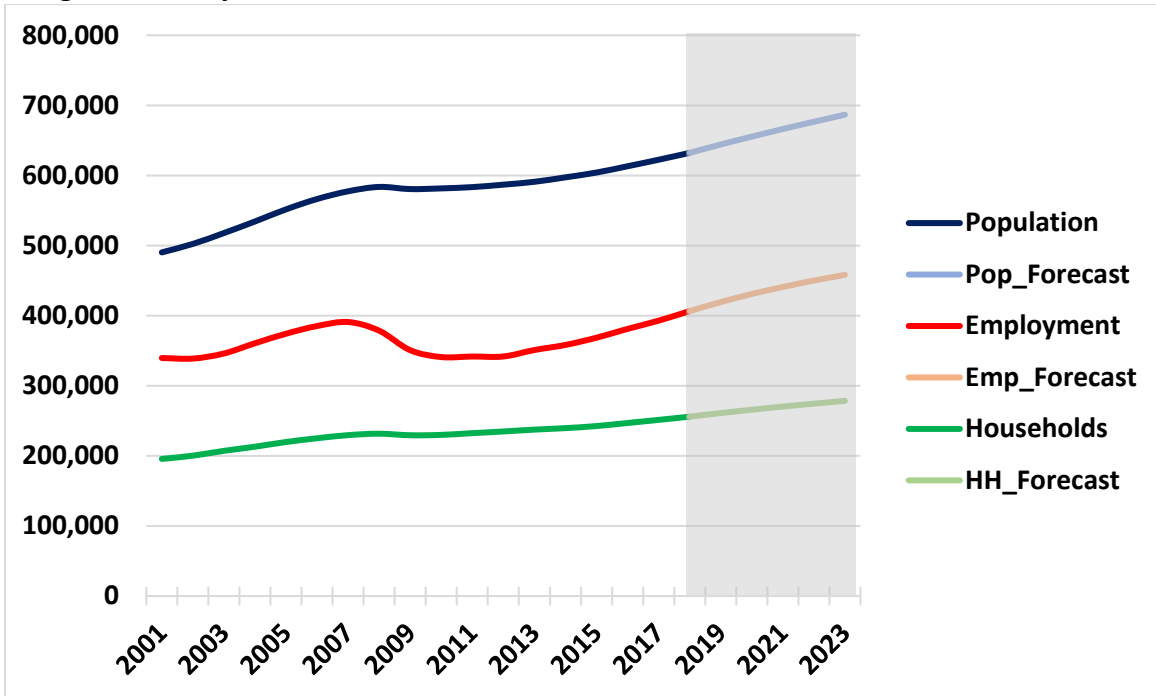
Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN
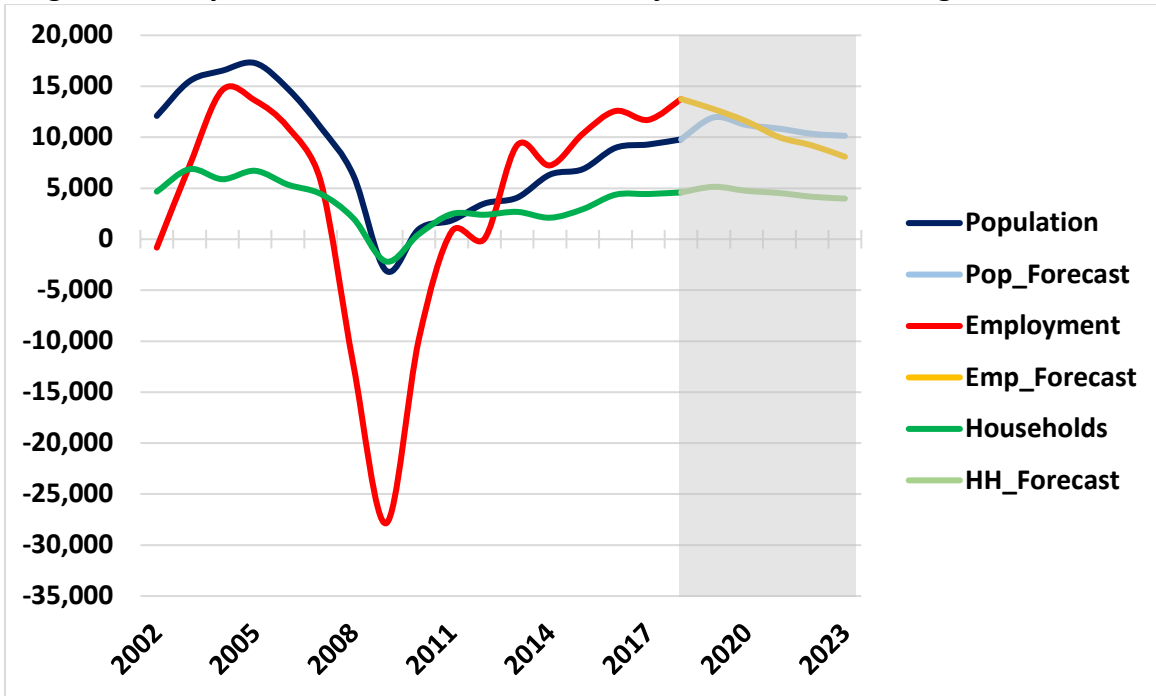
Figure 2: Study Area Consensus Historical & Forecasted Percent Change: 2019 – 2023

Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN

Figure 3: Study Area Consensus Historical & Projected Absolute Change: 2019 – 2023

Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN

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Appendix: County-Level Forecasts

Table A: Study Area Consensus Forecast, by County: 2019 – 2023

Year	Carson City			Storey			Douglas		
	Pop	**Emp**	**HH**	**Pop**	**Emp**	**HH**	**Pop**	**Emp**	**HH**
2001	53,991	43,193	22,757	3,701	1,500	1,594	43,306	30,122	18,568
2002	55,008	43,095	23,170	3,650	1,602	1,571	44,345	30,213	19,001
2003	55,099	43,219	23,293	3,728	1,644	1,610	45,502	31,251	19,568
2004	55,997	44,386	23,594	3,787	1,798	1,630	47,676	32,545	20,435
2005	56,567	45,227	23,820	3,974	2,089	1,710	49,637	33,057	21,262
2006	56,676	45,383	23,818	4,037	2,380	1,733	50,851	33,130	21,738
2007	56,651	43,449	23,821	4,213	3,159	1,810	51,413	33,346	21,991
2008	56,623	42,213	23,767	4,310	3,255	1,848	51,247	32,168	21,881
2009	56,305	40,087	23,533	4,302	3,304	1,837	51,208	29,542	21,772
2010	56,097	39,067	23,464	4,253	3,306	1,817	49,460	28,138	21,045
2011	56,216	38,557	23,699	4,134	3,474	1,781	47,788	28,074	20,494
2012	55,388	37,918	23,453	4,099	3,801	1,773	47,968	28,018	20,662
2013	54,536	37,987	23,199	4,007	4,270	1,742	48,361	28,920	20,927
2014	54,034	38,115	22,948	3,979	5,194	1,726	48,612	29,240	21,001
2015	54,500	38,298	23,166	4,001	6,002	1,738	48,425	30,241	20,939
2016	55,523	38,884	23,676	4,068	7,647	1,772	48,533	30,423	21,053
2017	56,113	40,138	23,995	4,158	12,114	1,817	49,114	30,704	21,364
2018	56,726	41,543	24,319	4,269	12,538	1,870	49,710	31,778	21,679
2019	57,115	42,846	24,517	4,372	13,431	1,917	50,144	32,775	21,896
2020	57,497	44,026	24,703	4,473	14,288	1,964	50,544	33,678	22,090
2021	57,920	45,048	24,899	4,582	15,096	2,012	50,948	34,459	22,280
2022	58,387	45,987	25,100	4,692	15,879	2,061	51,340	35,178	22,451
2023	58,904	46,813	25,312	4,810	16,629	2,112	51,763	35,810	22,626

Table A: Study Area Consensus Forecast, by County: 2019 – 2023, Continued

Year	Lyon			Washoe			Consensus		
	Pop	Emp	HH	Pop	Emp	HH	Pop	Emp	HH
2001	37,205	14,752	14,289	352,097	250,067	138,433	**490,300**	**339,634**	**195,640**
2002	38,893	14,634	14,927	360,498	249,265	141,644	**502,393**	**338,810**	**200,312**
2003	41,154	15,161	15,853	372,411	254,761	146,858	**517,893**	**346,037**	**207,181**
2004	44,528	16,208	17,096	382,436	265,730	150,312	**534,424**	**360,666**	**213,067**
2005	48,401	17,843	18,571	393,117	276,049	154,414	**551,698**	**374,266**	**219,777**
2006	53,071	18,733	20,323	401,820	285,616	157,517	**566,456**	**385,242**	**225,129**
2007	54,864	19,254	21,021	410,296	291,729	160,931	**577,438**	**390,938**	**229,573**
2008	54,873	18,655	20,987	416,642	282,303	163,132	**583,694**	**378,594**	**231,615**
2009	53,634	16,762	20,426	415,153	261,040	161,858	**580,602**	**350,736**	**229,427**
2010	52,565	16,329	20,034	419,223	254,138	163,569	**581,597**	**340,978**	**229,929**
2011	52,583	16,525	20,199	422,719	255,106	166,232	**583,440**	**341,737**	**232,404**
2012	52,194	16,675	20,139	427,289	255,371	168,775	**586,938**	**341,784**	**234,802**
2013	52,832	16,968	20,479	431,280	262,867	171,135	**591,016**	**351,013**	**237,482**
2014	53,408	17,747	20,668	437,323	267,957	173,248	**597,355**	**358,253**	**239,591**
2015	53,500	16,803	20,722	443,797	277,248	175,969	**604,224**	**368,592**	**242,534**
2016	53,975	17,060	20,972	451,088	287,152	179,430	**613,188**	**381,166**	**246,904**
2017	54,991	17,378	21,427	458,101	292,536	182,732	**622,477**	**392,871**	**251,335**
2018	55,953	17,987	21,858	465,609	302,775	186,199	**632,267**	**406,621**	**255,925**
2019	*56,517*	*18,551*	*22,106*	*476,074*	*311,772*	*190,629*	***644,221***	***419,375***	***261,066***
2020	*57,131*	*19,062*	*22,366*	*485,773*	*319,874*	*194,686*	***655,418***	***430,928***	***265,809***
2021	*57,778*	*19,504*	*22,632*	*495,035*	*326,819*	*198,512*	***666,263***	***440,926***	***270,336***
2022	*58,425*	*19,911*	*22,886*	*503,753*	*333,164*	*202,004*	***676,598***	***450,119***	***274,500***
2023	*59,089*	*20,269*	*23,136*	*512,171*	*338,686*	*205,297*	***686,737***	***458,206***	***278,484***

Note: Forecast years in shaded area.
Sources: IHS, W&P, NSD, BEA, RCG, TMWA, EMSI, EDAWN