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**BAKERSFIELD**™

School of Business and  
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Volume 26, Issue 2

# Kern Economic Journal

Winner of the Award for Merit from California  
Association for Local Economic Development

2024 Second Quarter



## Featured Articles:



Biodegradable Soil  
Sensors: A Primer



Federal Employee Rules:  
What Every Manager  
Should Know



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*KERN ECONOMIC JOURNAL* is a quarterly publication (February, May, August, November) of California State University, Bakersfield. Its purpose is to track local trends and analyze regional, national, and global issues that affect the economic well-being of Kern County. The journal provides useful information and data that can help the community make informed economic decisions. Sources of funding for this journal include university contributions and sponsorship and subscription fees.

Editorial and analytical articles on important local, regional, national, and international issues and trends are invited for *consideration* of publication in the journal. Articles (not exceeding 800 words in length) must be submitted to the Managing Editor in electronic copy. Individual authors are responsible for the views and research results.

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# Kern Economic Journal



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# Economy at a Glance!

2024 SECOND QUARTER  
BY DR. NYAKUNDI MICHIEKA  
& DR. RICHARD S. GEARHART III

## National Economy<sup>1</sup>

Real GDP increased at an annual rate of 2.8 percent in the second quarter of 2024. In the first quarter of 2024, real GDP increased by 1.4 percent.

The increase in real GDP reflected increases in consumer spending in both goods (motor vehicles and parts, recreational goods and vehicles, furnishings, household equipment, gasoline and other energy goods) and services (healthcare, housing, utilities and recreation), private inventory investment (wholesale and retail trade), and nonresidential fixed investment. Imports also increased in the second quarter. These movements were partly offset by a downturn in residential fixed investment.

Current-dollar GDP increased by 5.2 percent (annual) or \$360 billion in the second quarter of 2024 to a level of \$28.63 trillion.

Current-dollar personal income increased \$233.6 billion in the second quarter. This rise reflected increases in compensation and personal current transfer receipts.

Real disposable personal income, which is adjusted for inflation and taxes, increased by 1.0 percent.

Personal saving was \$720.5 billion in the second quarter compared with \$777.3 billion in the first quarter.

Personal saving rate—personal saving as a percentage of disposable personal income—was 3.5 percent in the second quarter.

The Conference Board's Index of Leading Economic Indicators—a measure of future economic activity—decreased by 0.2 percent in June 2024 to 101.1 (2016=100), following a 0.4 percent decline in May.

The University of Michigan's Consumer Sentiment Index decreased from 78.4 in the first quarter of 2024

to 71.1 in the second quarter of 2024. The index in the second quarter of 2023 was 62.3, and 57.8 in the second quarter of 2022.

## State Economy<sup>2</sup>

In California, the unemployment rate decreased to 5.2 percent in the second quarter of 2024 compared to 5.3 percent in the first quarter. The counties (top 5) with the highest unemployment rates include: Colusa (13), Imperial (15.9), Kern (8.8), Merced (9.5) and Tulare (10.1). Those with the lowest unemployment rates include: Inyo (3.5), Marin (3.4), San Francisco (3.4), San Luis Obispo (3.5) and San Mateo (3.2).

California's labor force decreased by 6,733 in the second quarter of 2024. During this period, civilian employment rose by 5,633 workers (from 18.32 million to 18.33 million). Nonfarm enterprises hired 47,033 more workers while farm employment decreased by 14,333. The mining and logging sector hired 100 less workers while construction hired 4,800 less workers. The manufacturing sector also hired 14,933 less workers. Service sector employment increased from 15.70 million to 15.77 million between the first quarter of 2024 and the second quarter of 2024. The state government hired 3,333 more workers while the local government added 9,267 workers.

## Local Economy

The local economy witnessed a decrease in the labor force from 396,967 in the first quarter of 2024 to 391,300 in the second quarter of 2024. Civilian employment decreased by 766 from 357,233 to 356,467. Nonfarm employment increased by 2,900 while farming employment increased by 4,167.

In Bakersfield, nonfarm employment changed in the following manner: mining and logging gained 33 workers; construction added 233 workers; manufacturing lost 33 workers while the service industry added 2,667 workers. Within the service sector, trade, transportation and utilities added 233 workers. Financial activities added 33 workers, professional and business services added 267

<sup>1</sup>U.S. economic numbers were obtained from the Bureau of Economic Analysis "U.S. Economy at a Glance". This is found at <http://www.bea.gov/newsreleases/glance.htm>  
The information for the Index of Leading Economic Indicators is found at <https://conference-board.org/data/bcicountry.cfm?cid=1>.  
The University of Michigan Consumer Sentiment Index is found at <http://www.sca.isr.umich.edu/tables.html>

<sup>2</sup>The California economic numbers were obtained from the Bureau of Labor Statistics "Local Area Unemployment Statistics Map". This is found at <https://data.bls.gov/map/MapToolServlet?survey=la&map=county&seasonal=u>.



workers, private education and health services added 233 workers while leisure and hospitality gained 500 employees. Within the government, the number of federal government workers increased by 33 while the state government gained 33 workers. The local government added 1,133 workers.

Total salaries and wages in Kern County increased from \$360,033 in the third quarter of 2023 to \$362,700 (0.7 percent increase) in the fourth quarter of 2023. Compared to four quarters ago, salaries were higher by \$11,133 or 3 percent.

In Kern County, the unemployment rate varied considerably across cities, ranging from 3.4 percent in Ridgecrest to 27 percent in Delano. All cities in Kern County (in our sample) witnessed a decrease in the unemployment rate in the second quarter of 2024 (compared to the first quarter of 2024). The biggest quarter to quarter decrease in the unemployment rate occurred in Lake Isabella where it dropped from 23.8 percent to 21.4 percent. In Bakersfield, the unemployment rate was 5.87 percent in the second quarter of 2024 compared to 6.87 percent in the first quarter of 2024. Overall unemployment (in Kern County) was 8.9 percent in the second quarter of 2024 compared to 10 percent in the first quarter of 2024.

In the second quarter of 2024, the median price of a home in Bakersfield was \$405,317 compared to \$397,788 in the first quarter of 2024. Home prices

were \$13,317 higher than they were four quarters ago. Within the county, median home prices were lowest in the city of Taft, averaging \$278,250. The region where median home prices were highest was Rosamond (\$427,333).

The weighted price index for the five publicly traded companies doing business in Kern County (Sierra Bancorp, Tejon Ranch Company, Chevron Corporation U.S., Granite Construction, and Wells Fargo Company) increased by 5.1 percentage points from \$117.7 to \$123.7 (quarter to quarter). The index was also 25.3 percentage points greater than it were four quarters ago. All companies gained/lost as follows: Chevron (decreased 0.8 percent quarter-over-quarter), Tejon Ranch (increased 9.3 percent quarter-over-quarter), Granite Construction (increased 5.4 percent quarter-over-quarter), Wells Fargo (increased 4.5 percent quarter-over-quarter) and Sierra Bancorp (increased 10.1 percent quarter-over-quarter).

The average retail price of gasoline increased by \$0.38 to \$5.02 from \$4.64 a gallon (quarter to quarter). The unit price of California's Class III milk was \$17.97 in the second quarter of 2024 compared to \$15.86 in the first quarter of 2024. The Index of Farm Price Parity in the second quarter of 2024 (0.89) was higher than that of the first quarter of 2024 (0.85).

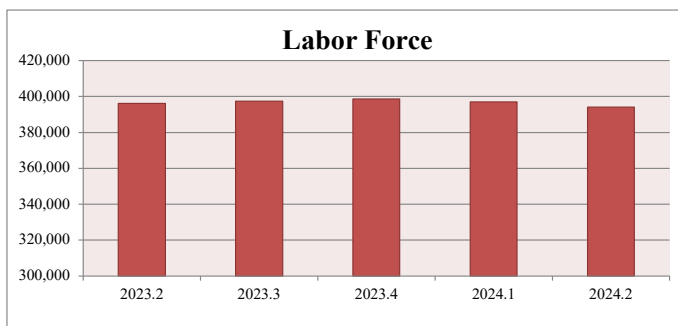
# Tracking Kern's Economy<sup>1</sup>

DR. NYAKUNDI MICHIEKA &  
DR. RICHARD S. GEARHART III  
2024 SECOND QUARTER

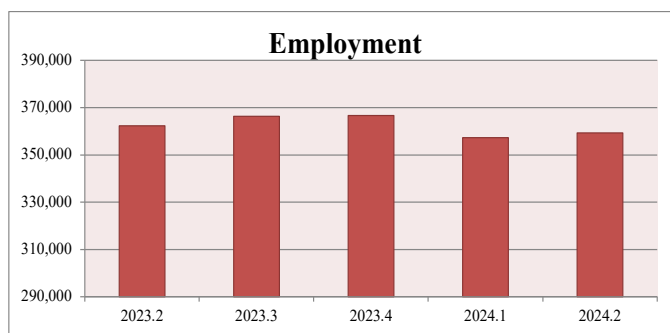
## Labor Market

*We average monthly data to calculate quarterly data then adjust for seasonality in the series.*

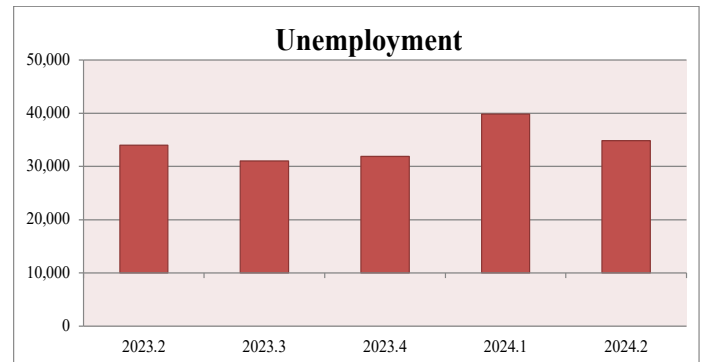
**Labor Force** – The civilian labor force decreased by 2,967 individuals, from 397,033 in the first quarter of 2024 to 394,067 in the second quarter of 2024. The labor force estimates for the second quarter of 2024 were similar to those recorded in the third quarter of 2019 where they averaged 394,000. The Bureau of Labor Statistics defines the labor force participation rate as the proportion of the working-age population that is either working or actively looking for work.



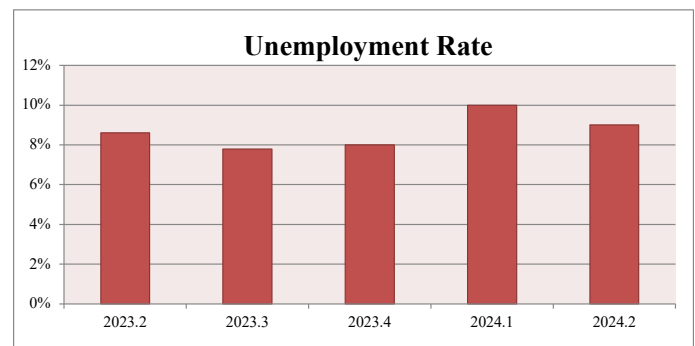
**Employment** – In the second quarter of 2024, Kern County hired 2,033 more workers (compared to the previous quarter) as total employment increased from 357,233 to 359,267. This is a 0.85 percent decrease in employment compared to the second quarter of 2023 when 362,333 persons were employed. Last year, first to first quarter (2023) employment increased by 2,467 while this year, first to second quarter (2024) employment increased by 2,033.



**Unemployment** – Quarter to quarter unemployment decreased by 4,967 as the number of jobless workers decreased from 39,800 to 34,833. The number of unemployed workers is 2.55 percent higher than it were four quarters ago. In the second quarter of 2023, there were 33,967 unemployed workers.



**Unemployment Rate** – Kern County's year-to-year unemployment rate increased by 0.4 percentage points from 8.6 percent in the second quarter of 2023 to 9 percent in the second quarter of 2024. The unemployment rate in the second quarter of 2024 was 9 percent. Kern County's second quarter unemployment rate (9 percent) was almost double that of California's (5.2 percent).

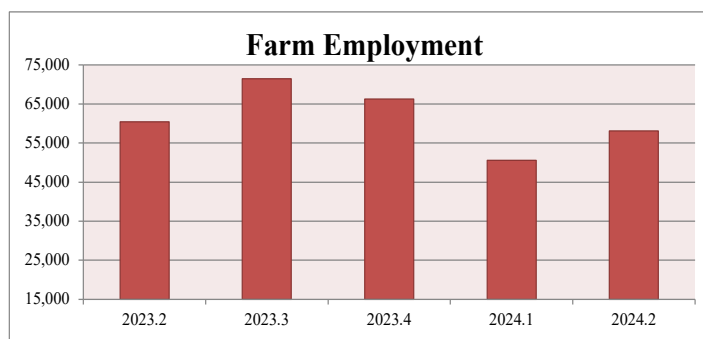


The unemployment rate varied considerably across cities, ranging from 3.4 percent in Ridgecrest to 27 percent in Delano. Quarter to quarter unemployment rate decreased in all cities (in our sample) in Kern County. The biggest decrease in the unemployment rate occurred in Lake Isabella, where it dropped from 23.8 to 21.4 percent. In Bakersfield, the unemployment rate was 5.9 percent in the second quarter of 2024 compared to 5.5 percent four quarters ago.

### Unemployment Rate of Cities

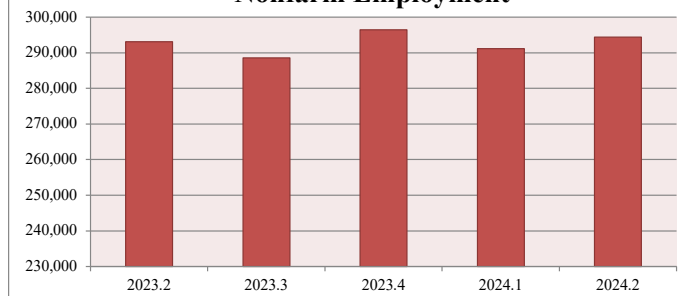
Location	Unemployment Rate (%)	Location	Unemployment Rate (%)
<b>KERN COUNTY</b>	8.9%	McFarland	7.9%
Arvin	11.4%	Mojave	8.6%
Bakersfield	5.9%	Oildale	14.0%
California City	18.0%	Ridgecrest	3.4%
Delano	27.0%	Rosamond	9.5%
Edwards	8.6%	Shafter	7.1%
Frazier Park	8.7%	Taft	6.0%
Lake Isabella	21.4%	Tehachapi	8.3%
Lamont	8.5%	Wasco	17.0%
Note: City-level data are not adjusted for seasonality and “informal” market workers.			

**Farm Employment** – In the second quarter of 2024, Kern County hired 7,500 more farm workers compared to last quarter. As a result, quarter to quarter farm employment increased to 58,067 from 50,567. An average of 60,467 workers were employed in the farming sector last year (second quarter of 2023). The year-over-year number of farm workers decreased by 2,400.



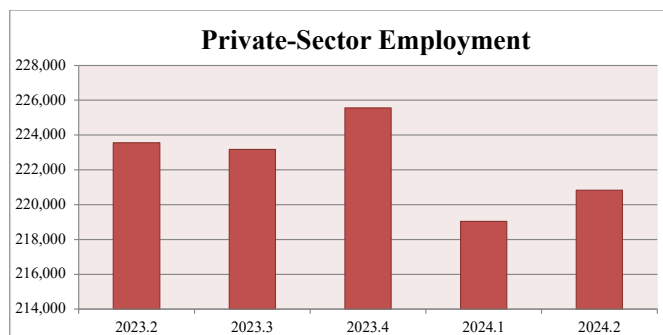
**Nonfarm Employment** – Local nonfarm industries employed 3,233 more workers in the second quarter of 2024 as the number of workers increased from 291,133 to 294,367. The industries hired 1,300 (or 0.44 percent) more workers compared to four quarters ago.

### Nonfarm Employment

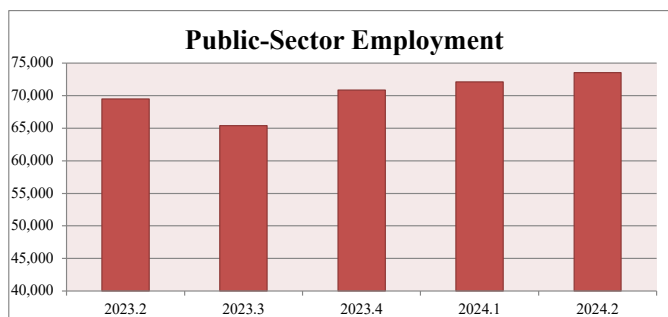


In Bakersfield, nonfarm employment changed in the following manner: mining and logging employment increased by 33 workers; construction gained 233 workers; manufacturing lost 33 workers while the service sector added 2,667 workers. Within the service sector, trade, transportation, and utilities added 233 workers; financial activities added 33 workers; professional and business services added 267 workers; health care and social assistance added 200 workers while leisure and hospitality added 500 workers. Federal government employment increased by 33 while the state employees increased by 33. The local government added 1,133 workers.

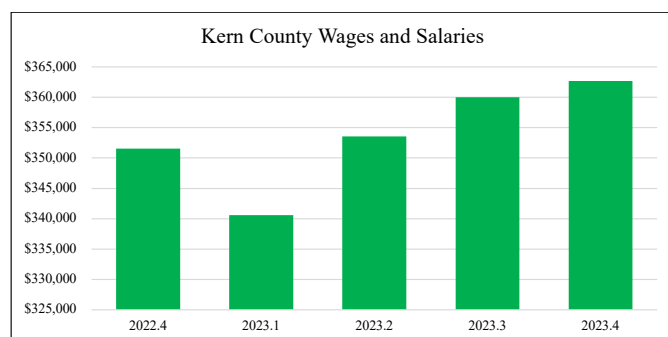
**Private-Sector Employment** – Nonfarm employment is comprised of private- and public-sector employment. In the second quarter of 2024, private companies hired 1,800 more workers compared to the first quarter of 2024. They also hired 0.8 percent more workers in the second quarter of 2024 than they did four quarters ago (in 2023). Today, the private sector employs 220,833 individuals.



**Public-Sector Employment** – The public sector consists of federal, state, and local government agencies. The local government labor market includes workers employed by county and city agencies, and public education. In the second quarter of 2024, government agencies hired 1,433 more workers, as employment increased from 72,100 to 73,533 – a 2 percent increase. Compared to the second quarter of 2023, 5.8 percent more workers were hired in the public sector.

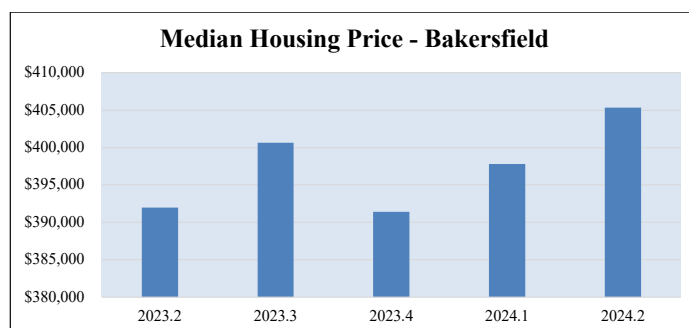


**Salaries and Wages** – Total salaries and wages in Kern County increased from \$360,033 in the third quarter of 2023 to \$362,700 in the fourth quarter of 2023 – a 0.7 percent increase. Compared to four quarters ago, salaries were \$11,133 (or 3 percent) higher.

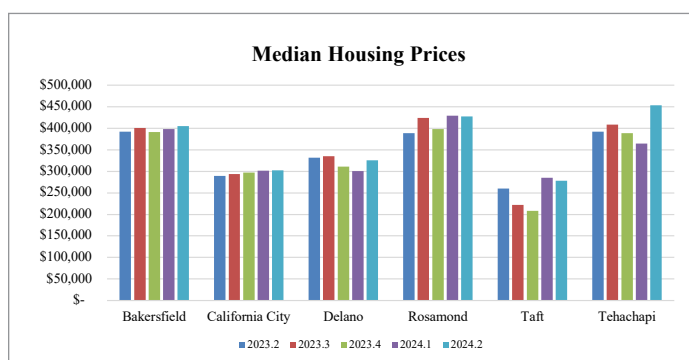


## Housing Market

**Housing Price** – In the second quarter of 2024, Bakersfield's housing prices were up by \$7,528 (1.89 percent) compared to the first quarter of 2024. The median price of a home in Bakersfield averaged \$405,317 (in the second quarter of 2024) compared to \$392,000 (in the second quarter of 2023). Prices were 3.4 percent higher than they were four quarters ago.



**Regional Housing Prices** – Changes in housing demand in Bakersfield are likely to spillover to surrounding cities as individuals who are on the margin of buying or selling are likely not located in the Bakersfield Metropolitan Statistical Area (MSA). An assessment of first quarter (2024) to second quarter (2024) changes in median sales price indicates that home prices increased in all cities in Kern County except for Rosamond and Taft where they decreased by \$2,000 and \$6,917, respectively. Tehachapi recorded the largest increase in home prices (+\$89,055). The average (annual) price change was +5 percent across all regions in the County. The median home price across all regions averaged \$365,437 in the second quarter of 2024 compared to \$342,192 last year (second quarter of 2023).

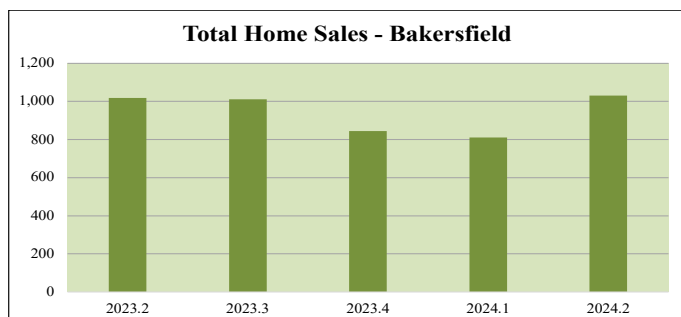


The year-to-year home prices changed as follows: Bakersfield (+3.4 percent), California City (+4.61 percent), Delano (-1.66 percent), Rosamond (+10.04 percent), Taft (+6.88 percent) and Tehachapi (+15.65 percent).

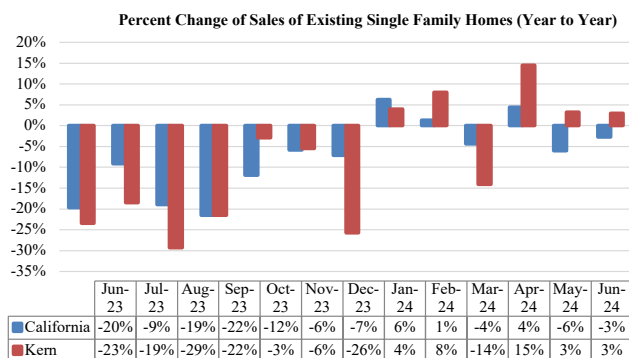


Location	Median Price (last year)	Median Price (this year)	Price Change (\$) (Annual)	Price Change (%) (Annual)
	2023.2	2024.2	2023.2 to 2024.2	2023.2 to 2024.2
Bakersfield	392,000	405,317	13,317	3.40%
California City	289,000	302,333	13,333	4.61%
Delano	331,333	325,833	-5,500	-1.66%
Rosamond	388,333	427,333	39,000	10.04%
Taft	260,333	278,250	17,917	6.88%
Tehachapi	392,167	453,555	61,388	15.65%
Average	342,194	365,437	23,243	6.49%

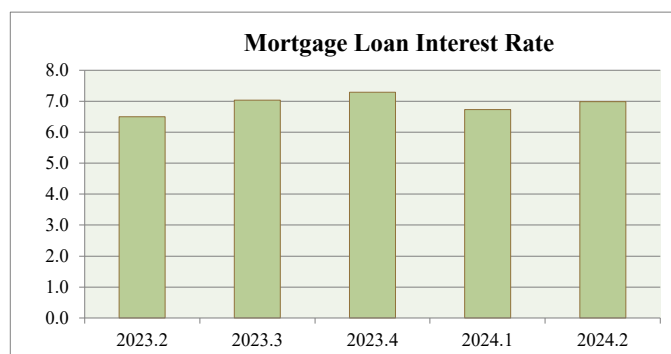
**Home Sales** – In Bakersfield, quarter to quarter sales of residential units increased by 220 units, from 811 in the first quarter of 2024 to 1,031 in the second quarter of 2024. An average of 13 more homes were sold in the second quarter of 2024 compared to the second quarter last year (2023).



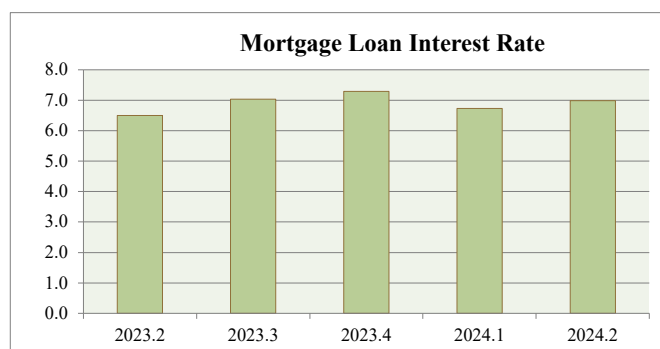
**Growth in Housing Sales** – We compare growth in sales of existing single-family homes in Kern County with growth in sales in California. Positive values indicate that more homes were sold this year compared to last year. In June 2024, 3 percent more homes were sold in Kern County compared to June last year. In California, sales were 3 percent higher this June compared to June 2023. The average growth in home sales in California between June 2023 and June 2024 was -8.3 percent while the number was -7.3 percent in Kern County. Interestingly, only March of 2024 recorded negative year to year growth in home sales (other months recorded more home sales this year compared to last year).



**New Building Permits** – In the second quarter of 2024, Kern County issued 30 more permits for construction of new privately-owned dwelling units compared to the first quarter of 2024. A total of 744 permits were issued this (second) quarter compared to 603 in the second quarter of last year (2023). The number of permits issued continues to surge. Over the last five years, the average number of permits issued in the first quarter of every year is 524.

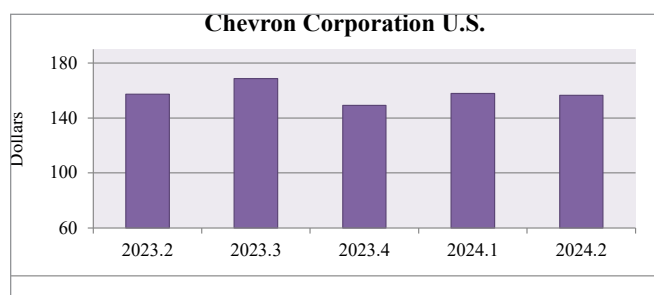


**Mortgage Interest Rate** – In the second quarter of 2024, the interest rate on thirty-year conventional mortgage loans increased to 6.99 percent (up from 6.73 percent in the first quarter of 2024). The interest rate last year (second quarter of 2023) was 6.49 percent.

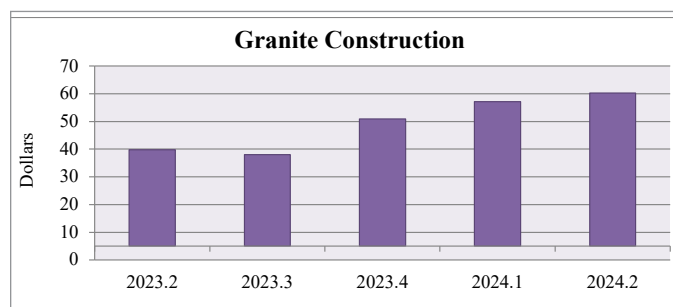


## Stock Market

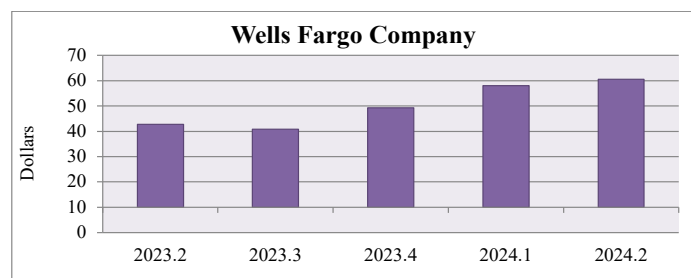
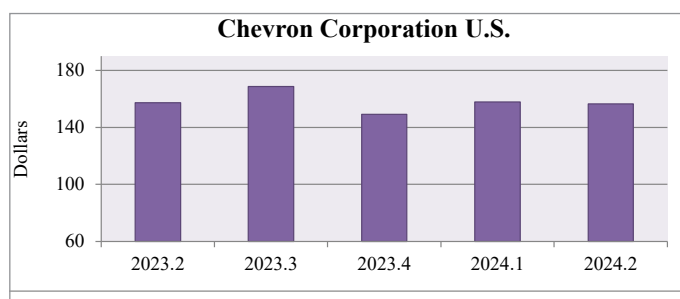
In the first quarter of 2024, the composite price index (2014.1=100) of the five publicly traded companies doing business in Kern County increased by \$5.75, from \$112.9 to \$117.7 (quarter to quarter change). The index was 19.1 percentage points higher than it were four quarters ago. Average “close” prices were measured for five local market-movers: Chevron Corporation U.S., Tejon Ranch Company, Granite Construction, Wells Fargo Company, and Sierra Bancorp.



**Chevron Corporation U.S.:** Compared to the second quarter of 2024, CVX lost \$1.22 (or -0.8 percent) per share as its price decreased from \$157.74 to \$156.52. Relative to the second quarter of 2023, CVX was down \$0.83 (or -0.5 percent).

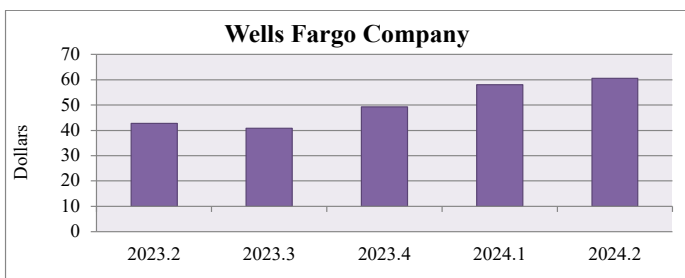
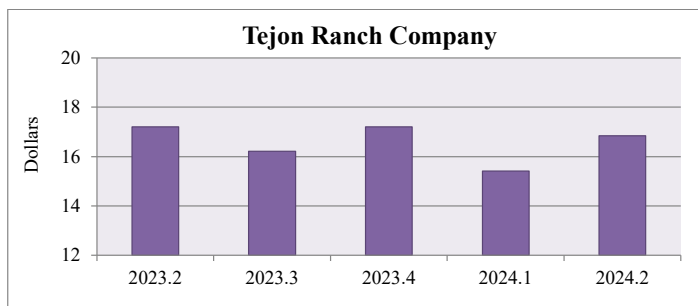


**Wells Fargo Company:** WFC gained \$2.63 (or 4.5 percent) per share as its stock price increased from \$57.96 to \$60.59 between the first quarter of 2024 and the second quarter of 2024. Relative to second quarter of 2023, WFC was up \$17.91 (or 42 percent).



**Tejon Ranch Company:** TRC gained \$1.43 (or 9.3 percent) per share as its stock price increased from \$15.41 to \$16.84 between the first quarter of 2024 and the second quarter of 2024. Compared to the second quarter of 2023, TRC stock price was down \$0.37 (or 2.1 percent).

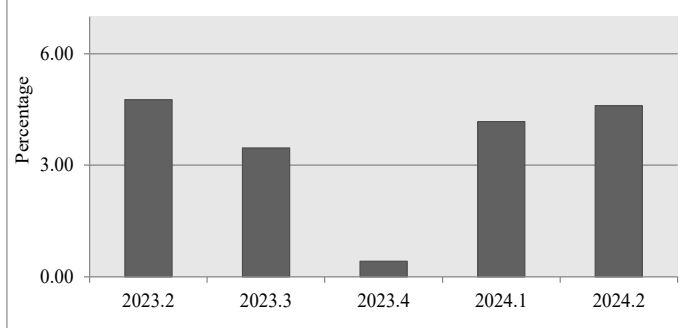
**Sierra Bancorp:** BSRR lost \$2.35 (or 10.4 percent) per share as its price decreased from \$22.55 to \$20.20 (quarter-to-quarter). BSRR gained \$2.98 (or 17.3 percent) in the second quarter of 2024 compared to the second quarter of 2023.



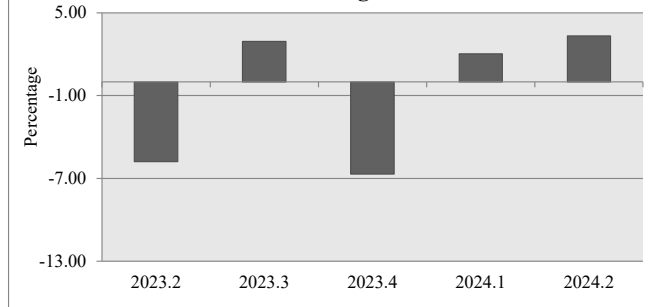
**Granite Construction:** GVA gained \$3.11 (or 5.4 percent) per share as its stock price increased from \$57.13 to \$60.24 between the first quarter of 2024 and the second quarter of 2024. GVA gained \$20.46 (or 51.4 percent) over the last four quarters.

**Cost of Living** – In the second quarter of 2024, the Consumer Price Index for all urban areas (1982-84 = 100) increased from 310.4 to 313.9. As a result, inflation for the cost of living accelerated at an annual rate of 4.6 percent. The index was 304.2 points in the second quarter of 2023.

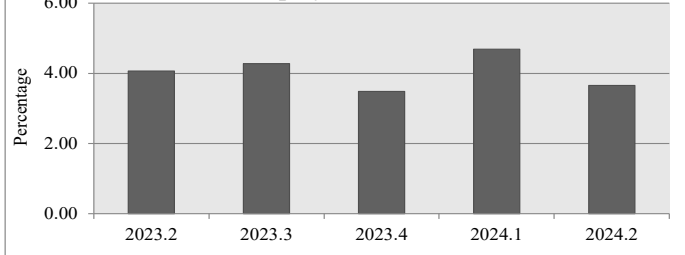
## Inflation

**Cost of Living Inflation Rate**

**Cost of Production** – The Producer Price Index for all commodities (1982 = 100) increased between the first and second quarter of 2024, from 253.78 to 255.89. The inflation rate for the cost of producing increased at an annualized rate of 3.32 percent. The cost of production inflation rate was 254.92 four quarters ago.

**Cost of Producing Inflation Rate**

**Cost of Employment** – The Employment Cost Index (December 2005 = 100) for all civilian workers increased from 164 in the first quarter of 2024 to 165.5 in the second quarter of 2024, causing quarter-to-quarter employment inflation to rise by 3.66 percent.

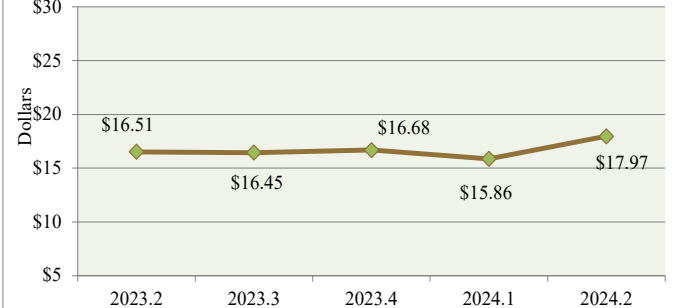
**Cost of Employment Inflation Rate**

## Commodity Prices

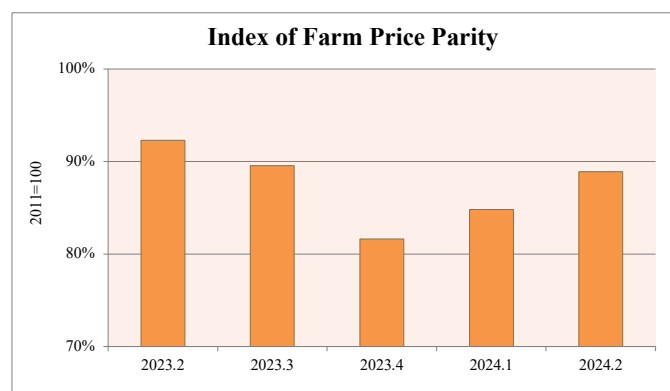
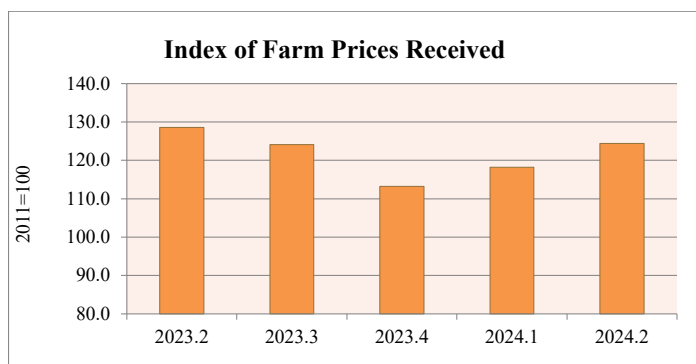
**Price of Gasoline** – In the Bakersfield MSA, the average retail price of gasoline increased by \$0.38 to \$5.02. Average gasoline prices were \$4.64 in the first quarter of 2024 and \$4.70 four quarters ago.

**Price of Gasoline in Bakersfield**

**Price of Milk** – The unit price of California's Class III milk increased in the second quarter of 2024 by \$2.11 to \$17.97. Milk prices were \$1.46 (or 8.8 percent) higher than they were four quarters ago.

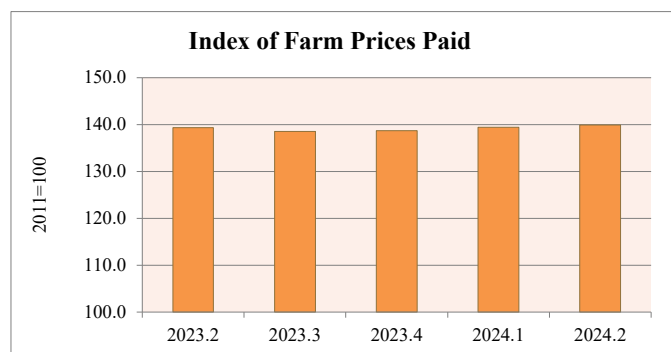
**Price of Milk in California**

**Farm Prices** – In the second quarter of 2024, the National Index of Prices Received by Farmers for all farm products (2011 = 100) increased by 6.17 points to 124.4 compared to 118.2 (in the first quarter). The index is 3.24 percent lower than it were four quarters ago (second quarter of 2023).



Meanwhile, the National Index of Prices Paid by farmers for commodities, services, interest, taxes, wages, and rents increased by 0.36 percentage points. This means that farmers were better off in the second quarter of 2024 compared to the first quarter of 2024.

<sup>1</sup> Source – Online databases: <http://www.labormarketinfo.edd.ca.gov>; [www.usda.com](http://www.usda.com); [www.bakersfieldgasprices.com](http://www.bakersfieldgasprices.com); [www.bea.gov](http://www.bea.gov); [www.car.org](http://www.car.org); [www.census.gov](http://www.census.gov); <https://www.redfin.com>; <https://www.cafmmo.com>; [www.bls.gov](http://www.bls.gov)



We measure the Index of Farm Price Parity as the ratio Index of Prices Received to the Index of Prices Paid. In the second quarter of 2024, the Index of Farm Price Parity was 89 percent compared to 85 percent in the last quarter. Four quarters ago, the price ratio was 95 percent.



# Biodegradable Soil Sensors: A Primer<sup>1</sup>

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## 1. Introduction

The United Nations (2024) estimates that the world's population will continue to grow over the next fifty to sixty years and reach a peak of 10.3 billion people in the mid 2080's, up from 8.2 billion in 2024. This will be accompanied by an increase in the aggregate demand for food, with agriculture central to meeting these needs. The environmental challenges associated with water and fertilizer use will also be enormous (Gopalakrishnan, et al. 2022). Obtaining accurate soil health information will play a central role in meeting these needs. Today, biodegradable soil sensors monitor soil conditions, assess nutrient availability, rooting conditions, oxygen availability, toxicity, and workability (FAO 2024 and Walter et al. 2017). The sensors also monitor plant health and stress, providing farmers with data to aid decision making (Li et al. 2024). Biodegradable sensors decompose over time, with nothing toxic remaining behind (Foundation 2024).

## 2. Literature Review: Fabrication and Operation of Sensors

Research on sensors is still at its infancy stage (Antonacci, Arduini et al. 2018). This article will summarize papers focused on biodegradable sensors then outline their advantages and disadvantages. Research on this area has focused on materials used to build sensors, the technology used to fabricate and characterize sensors, and their effect on the environment.

The studies by Bathaei, Singh et al. (2023) and Sreejith, Joseph et al. (2023) provide a comprehensive overview of the different biodegradable materials that have been used in the fabrication of sensors. These include polymers, co-polymers, silicon-based materials, proteins, metals (Bathaei, Singh et al. 2023) or beeswax blends (Atreya, Marinick et al. 2022). In earlier work, Kasirajan and Ngouajio (2012) outlined the history of using plastic mulch to build sensors, discussing their limitations and impacts on crop yield. The physiochemical and structural properties of plastic mulches have been examined by Brodhagen, Peyron et al. (2015), whose discussion involves insights from different fields (a microbiologist, polymer engineer, horticulturalist and plant pathologist). Their review underscores the need for collaboration amongst different sciences in developing and adopting these sensors. Work assessing the performance of these sensors under different scenarios is also common (Wawrzynek, Baumbauer et al. 2021, Stegner and Bauer-Reich 2024).

Recently, the performance of capacitive humidity sensors printed on different biodegradable materials, for example polylactide (PLA), glossy paper, and potato starch, is compared to that of nonbiodegradable polyethylene terephthalate (PET) (Wawrzynek, Emma et al. 2021). It was found that paper and starch sensors exhibited the highest overall sensitivity, while PLA sensors comparable response time as nonbiodegradable PET sensors.

Most studies opine that work needs to be done to improve the manufacturing process of sensors. The work by Yin, Cao et al. (2021), Soman and O'Neal (2010) and (Zaccarin, Iyer et al. 2023) focused on the fabrication technology in the development of their sensor. Yen and Kapetanovic (2024) discuss the challenges associated with designing and fabricating sensors; which include achieving long-range

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operational range, providing reliable power supply, balancing lifespan with decomposition rates, and environmental impacts.

Sensors measuring a variety of soil properties have been developed. Sakabe, Kan et al. (2024) developed sensors that measure soils' pH while Anichini, Aliprandi et al. (2020) evaluated soils' temperature. Others assess environmental humidity (Wawrzynek, Emma et al. 2021) soil moisture (Keshavarz, Lipman et al. 2021; Sui, Yougkun et al. 2021), chloride (Deng, Zuo et al. 2020) and water content (Singh, Kandasamy et al. 2024). Xu, Yuan et al. (2021) and Carvalho, Reis et al. (2024) focused on the antennae used in sensors while Yin, Cao et al. (2021) discussed those which measure nutrients, pests and pollutants.

The degradability of a biodegradable sensor, once deployed, may vary depending on exposure to water, oxygen, temperature, mulch thickness, and microbial community size and composition (Zhang, Flury et al. 2020). By encapsulating a rapidly degrading substrate and electrode in a slowly degrading wax blend, a clear distinction between the functional and nonfunctional lifetimes of the sensor is demonstrated in capacitive zinc-based soil moisture sensors (Sui, Yongkun et al. 2021). The material used to fabricate sensors may impact the soil quality during use. Li, Moore-Kucera et al. (2014) investigated the changes in soil quality during or following biodegradation of sensors while Zhu, Gurno et al. (2024) studied effects on plant growth.

### 3. Pros and Cons

The sensors operate during the growing season then degrade during harvest, eliminating the need to retrieve them (Sui, Atreya et al. 2021). They have changed the way farmers measure and respond to soils' health since they can assess the heterogeneity of soil characteristics remotely, using technologies such as the internet of things (Kim, Sudduth et al. 2009). Overall, biodegradable sensors are efficient since they allow farmers to minimize input while maximizing yield (Sudduth, Hummel et al. 1997).

Although this technology has progressed over the last few decades, challenges still exist. Maya Moreshwar Meshram, Adla et al. (2024) have outlined several issues impeding the widespread adoption of sensors, especially in low resource or remote regions. Sensors have batteries and electronic chips which makes them expensive (Gopalakrishnan, Waimin et al. 2022, Schwamback, Persson et al. 2023). The costs of purchasing them range from €300 to €1500 (\$335 to \$1700) while installation, operation and monitoring costs may be high depending on farm size (Kurth, Voigt et al. 2021). Battery replacements may be time consuming, especially in big farming operations (Daskalakis, Collado et al. 2017). The costs of cleaning and calibrating the sensors may also be high (Schwamback, Persson et al. 2023). A number of studies have reported that some sensors may produce inaccurate readings when operating within proximity of other electro-active elements (Palchetti, Laschi et al. 2009, Kosasih, Setiono et al. 2023). Micklin, Moestopo et al. (2024) found that sensors may deposit material in soil leading to environmental waste (Schwamback, Persson et al. 2023). They can also pollute soil and water bodies once obsolete (Gopalakrishnan, Waimin et al. 2022).

Future work ought to assess performance of sensors on the farm, in addition to in the lab. The lifetime and degradation behavior of these sensors have not been fully understood beyond the functional period (Waimin, Jiang et al. 2021). Studies looking at battery performance, reliability of data transfer and economic benefits of the technology will contribute to the literature (Kurth, Voigt et al. 2021).

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# Federal Employee Rules: What Every Manager Should Know

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Many of you as managers are acutely aware that employees represent one of the most essential and highly valued assets of your organization. The federal government noting this reality, created a set of laws, rules, regulations and protections for both the employer and employee so that long term success in the workplace is possible.

As early as 1941 preparing for post war growth, President Franklin D. Roosevelt signed an Executive Order establishing federal guidelines for fairness in the workplace. In 1964 as a part of the Civil Rights Act, the U.S. Equal Employment Opportunity Commission [EEOC] was created to ensure protections for both employers and employees.

Over time various laws, amendments, and executive orders have shaped the direction of fair employment in the U.S. The Equal Employment Opportunity Act of 1972 gave the EEOC authority to create and monitor various laws, rules and regulations that currently impact the work world.

There seems to be and in reality is, a mountain of critical information that a manager must be aware of to be in compliance with these federal mandates. The following is a short overview of the four most critical items pertinent to the responsibility of a manager in the employment area.

## **Rule: *Non-Discrimination***

**Overview:** Managers should ensure that applicants and employees are not discriminated against or harassed because of race, color, religion, sex (including pregnancy, sexual orientation, or gender identity), national origin, disability, or age (40 or older) or genetic information (including family medical history).

This is a far-reaching rule including the following areas [1] position advertisements [2] recruitment [3] applications and hiring [4] some aspects of using information from background checks [5] job referrals [6] assignments and promotions [7] pay and benefits [8] discipline and discharge [9] training and professional development and [10] in some cases dress code.

## **Rule: *Reasonable Accommodation***

**Overview:** Managers should know how to recognize and respond to requests for reasonable accommodations (changes to the way things are normally done at work) because of an applicant's or employee's medical condition or religious beliefs.

A reasonable accommodation is [1] an adjustment [2] that is fair (through it may not be equal to all parties) [3] that is reasonable to both the employee and employer [4] that does not interfere with the work environment, and [5] that does not come at undue expense to the employer. There are times when the employer and employee disagree about the type of accommodation and the EEOC can be consulted for advice. It is also possible that the issue may need to be decided by the courts.

**Rule: *Responding to Discrimination Complaints.***

Overview: Managers should be able to recognize and respond promptly and effectively to discrimination complaints.

Both the employee and employer have responsibilities here but for the manager they must [1] know that an employee has the right to file a complaint with the EEOC claiming work site discrimination [2] that the process between the employee and EEOC is confidential until the complaint has been filed [3] a fact finding investigation lead by the EEOC may occur and the manager must fully and completely participate [seeking legal counsel if desired] [4] informal mediation attempts will be made to resolve the issue if possible, and [5] remedies will be authored by the EEOC seeking fair resolution.

**Rule: *Avoiding Retaliation.***

Overview: Managers should ensure that applicants, employees, and former employees are not punished for reporting discrimination, participating in a discrimination investigation or lawsuit, or opposing discrimination (for example, threatening to file a discrimination complaint).

The manager may not [1] reprimand an employee for filing a complaint [2] give unfair performance evaluations because of a complaint [3] transfer the employee solely on the basis of the complaint [4] participate in any form of physical or verbal abuse [5] increase scrutiny of the employee and their work and [6] make work more difficult.

Managers should not view federal employment rules or the EEOC as adversaries to the success of the workplace but as a valued partner in creating and maintaining a fair and safe work environment for both the employer and employee. Working within these guidelines better ensures that the manager will be comfortable in their critical employee decision making responsibilities.











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