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Gasoline Discount Programs in Lakewood, Colorado: A Cost-Saving Analysis

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Abstract
Using gas price data and discount or cashback offers collected in Q4 of 2022, we examined which among four programs: wholesale club membership; grocery store fuel points; gas station loyalty programs; and third-party mobile applications, would likely provide the most savings to alternative demographics proxied by faculty, staff and students on campus, as well as the average American consumer. Though what's best ultimately depends on personal circumstances, the key result from this research was that for the average American consumer who buys about 45 gallons of regular gas per month, Costco gas is best only if we disregard and exclude the membership fee in the cost of gas. Otherwise, Costco gas is best for premium gas only, and cedes supremacy to the third-party app Upside for regular gas. Upside is best for midgrade gas too. However, grocery fuel points supersede both Costco and Upside if the consumer spends about $300 or more and redeems the points for discounts at the pump. Ultimately, the study shows that consumers in both the high-spending and low-spending demographic may need to reassess their circumstances and reconsider their options to avoid potentially losing about $124 and saving $126 on gas a year.

Keywords: Gas Prices, Loyalty Programs, Fuel Points, Colorado

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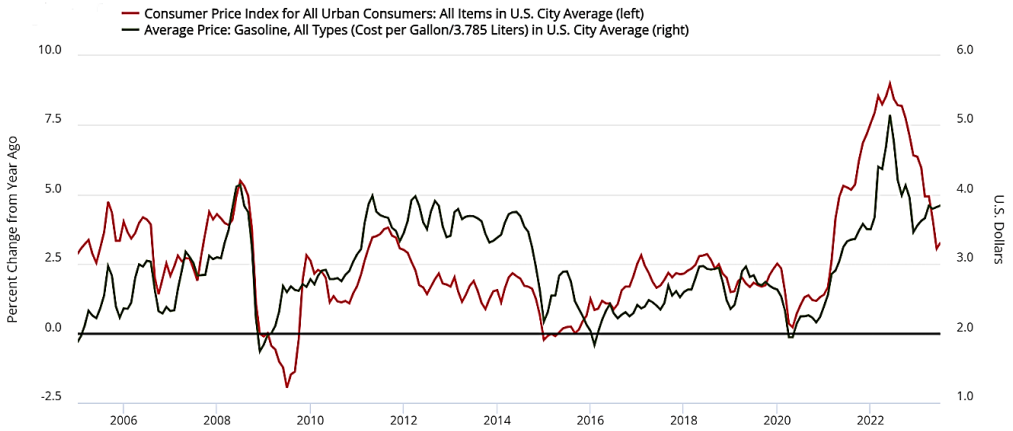
I. Introduction

If the year 2022 were to be summed up in one economic word, that word would be inflation. Post-covid supply chain bottlenecks and rebounding consumer demand both contributed to rising prices globally, including in the energy sector. In June, the Wall Street Journal (2022) published an article titled "gasoline prices reach $5 a gallon nationwide for the first time." Indeed, a closer look at the data reveals that the average price of gasoline in the United States, surpassed the post-2008 crisis peak to reach a new record high of $5.15 a gallon in June. At the time, many analysts suspected gas prices will continue to sky-rocket, few predicted it would soon start to fall back to pre-pandemic levels. Whatever the case, figure 1 suggests consumers can expect gas prices to fluctuate considerably over time.

Figure 1: U.S. Inflation, and average price per gallon of gasoline, all fuel grades in U.S. cities



Source: U.S. Bureau of Labor Statistics (2023)

Motor gasoline is a major commodity, and in 2022, the U.S. alone consumed 135.06 billion gallons, or 370 million gallons a day, the most of any country (U.S. Energy Information Administration, 2024). Rising gas prices can therefore be expected to have a significant impact on family budgets, and perhaps prompt changes in consumer behavior that embraces penny-pinching frugality. According to a survey by the American Automobile Association released on March 9th, 2022, almost 75% of American drivers responded that 5-dollar gas prices would prompt them to adjust their lifestyles. The majority indicated they would drive less, 18-to-34-year-olds said they would consider carpooling, and older Americans said they would combine trips and errands and reduce shopping and dining out (Carpenter, 2022). Therefore, any means to potentially lower the cost of gas must be of paramount importance to thousands of households, including in Colorado even though the total motor gasoline consumption is less than 2% of the U.S. total.

Today, many Americans already use loyalty programs, coupon codes and cashback shopping extensions such as Rakuten, Honey and Capital One to save money on most consumer purchases. However, the extent to which such means to save are being applied and utilized in the gas market is yet to be investigated. Like in other markets, consumers can effectively lower their gasoline costs by taking advantage of discounts as retailers engage in sophisticated pricing strategies to price discriminate. Despite gas stations being in a market structure that economic theory classifies as perfect competition with one price for all, no two consumers necessarily pay the same price. They certainly need not to, given the multitude of ways that allow consumers to effectively lower the price they pay per gallon of gasoline.

To charge different prices to different consumers, gas stations have adopted discount programs ranging from loyalty rewards programs to grocery store shopping points that can be redeemed for cents off per gallon. Third party applications have also entered the game offering cashback via smartphone applications. To utilize the discount and therefore pay lower prices, consumers must overcome what Stevenson and Wolfers (2021) refer to as hurdles.

For example, to earn fuel points on purchases of eligible items, the grocery store may require you to sign up or create an online account. Some require you to apply for a specified credit card or link a debit card to a checking account. These points can then be redeemed for per gallon discounts at their gas stations, but one must track and use points before they expire and remember to enter the unique ID number or scan the store card at the pump every time before filling up. These extra steps are hurdles and can be real obstacles for some.

Mobile applications are typically a smartphone app by a third-party company that partners with gas stations to offer cashback or discounts. The cashback is a fraction of the total paid at the pump that is transferred to the consumer's smartphone wallet or bank account. Discounts appear as a reduced price on the mobile app. In this case, hurdles include first installing the app, then opening it to compare cashback or discount offers to claim one before heading out to the gas station.

By design, the hurdles effectively segment the market into two groups to facilitate price discrimination. One group consists of individuals who feel it is too costly and cannot be bothered to deal with the hurdles. These are the prime candidates for a higher price who therefore simply pay the pump

price. The second group are generally more price sensitive, and thus elect to overcome the hurdles and save per gallon.

Another discount program, that is not price discriminatory per se, is membership of a wholesale club such as Costco and Sam's club. The pump price at their gas stations is consistently lower than all other competitors in the market, however these clubs do require an annual membership fee that a consumer may need to consider.

Some gas discount programs are well known but perhaps less utilized, while others are hardly known at all. For example, when we surveyed faculty, staff and students at a university campus in Lakewood City in Denver, 95.5% of faculty and staff, and 69.1% of students were familiar with grocery store fuel points, but only 45.5% of faculty and staff, and 45.6% of students were familiar with gas station loyalty programs. A mere 4.5% of faculty and staff, and 12.5% of students were familiar with cashback applications. 9.6% of students were not familiar at all with any discount programs. We thus embarked on a research study to evaluate alternative discount programs and illustrate how different consumers can lower their gasoline costs by utilizing the means that suit them best.

A. Research Objectives and Hypothesis

Our first and overall objective was to discover which program can be identified as best overall to effectively lower the pump price: wholesale member prices, grocery store points, gas station loyalty reward programs, or third-party mobile applications. Our a priori hypothesis was that lower gas prices enjoyed through membership of the wholesale club Costco, even after counting in the annual membership fee, is the best overall for the most savings at the pump.[1]

Our second objective was to compare the discount programs based on fuel grades; regular, midgrade, and premium gas. Our survey on campus had shown that 77.3% of faculty and staff typically buy regular gas, 18.2% buy midgrade, and 4.5% buy premium gas. The distribution was similar for students, 79% typically buy regular, 8.5% midgrade, and 5.5% buy premium gas.

Lastly, because some individuals, such as families, will spend more on groceries and therefore earn more points for larger gas discounts than say singles or students, our third objective was to make recommendations that may best suit the consumer. Likewise, membership of a wholesale club might make more sense to larger families, but could the savings from lower gas prices offset the membership fees and make it worthwhile for singles and students? Ultimately, we sought to provide a framework through which any consumer can make a personal assessment and deduce what might best fit their circumstances to save on gas.

II. Literature Review

It should first be noted that because there is hardly any empirical independent research preceding ours, we mostly relied on private webpages and sites to find information on gas discount programs and user opinions.

Our research revealed that there are many discount programs, most are offered as loyalty programs that are specific to the brand or company. For example, consumers can sign up for the free inner circle membership and get 3 cents off per gallon,

[1] A priori (literally: 'from the former') hypotheses are those based on assumed principles and deductions from the conclusions of previous research and are generated prior to a new study taking place (York Health Economics Consortium, 2022).

and up to 5 cents off when they spend $500 or more on fuel and merchandise (Circle K, 2024). Kerr (2022a) highlighted this as one of the best ways to save only if consumers also sign up and pay using the Easy Pay debit card to save 30 cents per gallon for the first 100 gallons or 60 days, thereafter it reverts to 10 cents off.

Another is the Exxon Mobil Rewards Plus program. Users earn 3 cents per gallon in points, and 2 cents per dollar (in points) using the rewards plus card for qualifying purchases other than gas. Points can be used to save money at the fuel pump and in the store (Exxon Mobil, 2022). Kerr (2022b) however noted that the savings are not per gallon but a flat dollar amount, and thus deemed the program as least lucrative. Another, the BPme rewards program saves up to 5 cents per gallon at BP and Amoco gas stations but requires one to spend 100 dollars on fuel each calendar month to keep the rewards going (BP United States, 2022).

Hopkins (2022) who writes for an automotive news site sought to rank the best seven fuel rewards programs in 2022. In her analysis, Shell Fuel Rewards, which offers 5 cents off per gallon to every signed-up member, claimed the top spot primarily due to convenience; “you can find a Shell gas station in almost any city in the country (USA).” The next two on her list, were also gas station loyalty programs with overall discounts ranging from 3 to 10 cents per gallon. However, since no comparisons were made to wholesale club prices, grocery store fuel points programs, and third-party applications, it is questionable to deduce that the ranked seven are the best.

Indeed, Kunesh (2022) for example, exalted a third-party application GasBuddy as the discount program to use ahead of long summer trips and in response to fuel price surges. He asserted that users can earn additional discounts only if their identity is verified and pay using the GasBuddy credit or debit card. Writing for the Denver7 news, Matarese (2022) also reported that GasBuddy was the most popular app to find lowest prices near you but highlighted that GetUpside (now Upside) was the newest cashback program to save money that was getting good reviews.

In addition, Kerr’s (2022b) analysis later in September 2022 proved that gas station programs on their own are not the most worthwhile indeed. He agreed with Hopkins (2022) claiming that Shell Fuel Rewards was the most rewarding for him in saving at the pump, but only when you link the fuel rewards account to a credit or debit card that you use for other qualifying purchases to earn additional points for discounts. For example, if you spent $50 at a participating restaurant, $50 shopping online, and $50 on concert tickets, you would earn 10 cents off, 5 cents off, and 10 cents off per gallon respectively. Add that to the base 5 cents off (gold status), you would get 30 cents off per gallon and lower the pump price from say $3.80 to $3.50 per gallon for up to 20 gallons on your next refill (Fuel Rewards, 2022).

Another consideration could be the popular low price retail store Walmart. Their Walmart plus membership is also a means to save on gas, up to 10 cents off per gallon at more than fourteen thousand locations nationwide including Exxon, Mobil, Walmart and Murphy stations (Walmart, 2022). The membership fee, however, is $98 a year, which is a rather significant cost for the savings. In comparison, Costco, whose membership costs $60 a year, had its average gas price 19.8 cents lower than its competitors in 2015, earning it the

GasBuddy overall low-price award for the fourth year in a row (GasBuddy, 2016).

Overall, almost every grocery store and gas station chain now have their own fuel savings program. But these must be compared to other discount programs for a consumer to properly deduce what is best for them. We can roughly categorize all discount programs into four: gas station loyalty rewards; wholesale club member prices; grocery store shopping points; and third-party mobile applications. The following section describes the research methodology we used to evaluate the discount programs in pursuit of the stated research objectives.

III. Research Methodology and Data

The extent to which discounts would be of value to a user largely depends on distance to the gas station. Thus, to make a fair comparison, our first step was to identify a central location and examine programs within a specific radius. Based on our residence in Lakewood city in Denver and affiliation to Colorado Christian University (CCU), we identified the Lakewood campus as our central location. Lakewood is also a semi-commercial and semi-residential city near shopping centers and gas stations. It was therefore ideal to explore and compare all four discount programs: wholesale club member prices, grocery shopping points, gas station loyalty rewards, and third-party mobile applications.

We also presumed that our post-study recommendations would depend on the driving needs and expenditure levels of the user. Thus, two additional reasons compelled our location of choice; first, we determined that a university campus was ideal with a population that fits two distinct demographics. The first group, faculty and staff could serve as a proxy for households of family size who are thus expected to spend more on gas and groceries, i.e. the high-cost consumers. The second group, students, could serve as a proxy for singles who are expected to spend less on gas and groceries, i.e. the low-cost consumers. Both results could thus be used to make some inferences or recommendations for consumers beyond the sampled population. Section III.A shows some of the gasoline consumption patterns identified from surveying the population.

A. Understanding the Gas Consumption Behavior of the Population

We randomly sampled and surveyed the university campus population to collect consumption data as well as information on their awareness and utilization of gas discount programs.[2] This included commuting distance, monthly expenditure on gas, and the fuel grade they buy among others. Figure 2 illustrates some of the survey results.

[2] The survey was administered between October and December 2022. Survey questions can be viewed via this link.

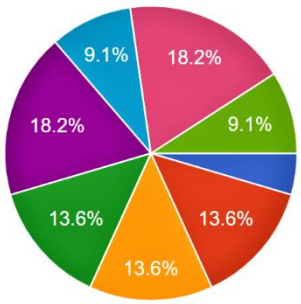
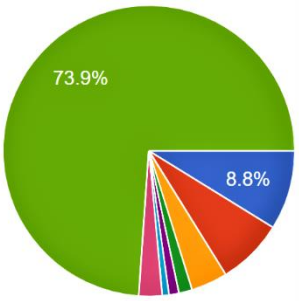
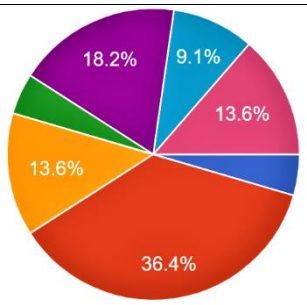
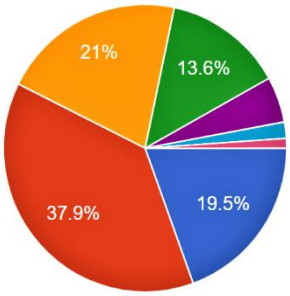
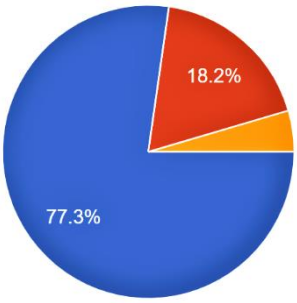
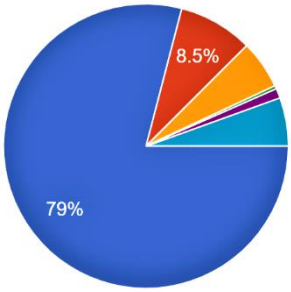
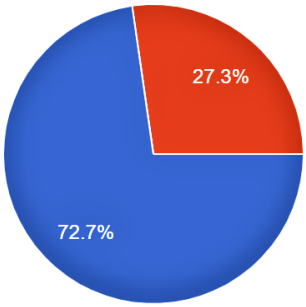
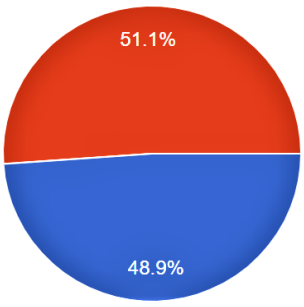
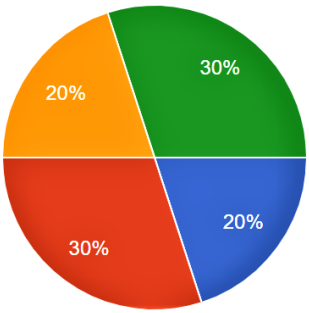
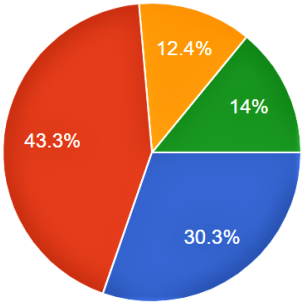
	Faculty and Staff (Proxy for high-cost consumers)	**Students** (Proxy for low-cost consumers)
Commuting distance to CCU Less than 1 mile 1 – 3 miles 3 – 6 miles 6 – 10 miles 10 – 15 miles 15 – 25 miles Over 25 miles Not applicable		
Monthly expenditure on gas $0 - $50 $51 - $100 $101 - $150 $151 - $200 $201 - $250 $251 - $300 Over $301		
Grade of gas typically bought Regular Mid-grade Premium I don't buy one specific grade. Other, i.e. Diesel Not applicable, i.e. I drive an electric vehicle, or have no car		
Do you go to a specific gas station? Yes No		
If no specific station, how do you decide which station to go to? I go wherever is closest. I check prices and go wherever is cheapest. I don't really think about it; I just go to any station when I need gas. None of the above apply to me.		

Figure 2: Gas consumption survey outcomes

As expected, the high-cost group overall spends more on gas, presumably due to work commutes and/or family size unlike the low-cost group, mostly students residing on campus. Interestingly, approximately 78% of all the respondents buy the cheapest grade of gas, irrespective of any differences in demographic factors such as income and driving distances.

We also found that 27% of the high-cost group and 51% of the low-cost group do not frequent any specific gas station; 20% and 30% respectively go to wherever is closest, and 20% and 12% respectively just go to any station when they need gas. 30% and 43% take the extra step to check prices and go wherever it is cheapest. This variation in behavior suggests that there exist consumers who may benefit from the analysis of alternative discount programs presented in this study.

The survey also asked respondents to select all discount programs that they are familiar with, and the ones they utilize, within all four categories. Table 1 shows a summary of the results.

Table 1: Knowledge and utilization of gas discount programs – survey outcomes*

	Faculty and Staff (Proxy for high-cost consumers)		**Students** (Proxy for low-cost consumers)	
Program	Know it (%)	Use it (%)	Know it (%)	Use it (%)
Safeway Rewards	72.7	27.3	34.9	12.5
Kroger Fuel Points (King Soopers)	95.5	68.2	69.1	37.5
Wholesale clubs e.g. Costco, Sam's club	81.8	59.1	56.3	27.2
Gas station loyalty e.g. Shell fuel, Circle K, Exxon	45.5	13.6	45.6	8.8
Third party apps e.g. Upside, GasBuddy	4.5	0.0	12.5	8.7
Other Information				
I am not familiar with any of these programs	0.0		9.6	
I use other savings programs	0.0		0.3	
I do not use any gas savings programs	4.5		37.1	

* Based on a survey administered to a campus population of over 1,500 between October and December 2022.

First, the survey showed that over 90% of all the respondents are familiar with gas discount programs. On the one hand, despite this high awareness, less than 5% of the high-cost group, faculty and staff, utilize gas discounts. Perhaps the hurdles are inconvenient, and/or they are just unaware of how much they can save to determine worth. On the other hand, the fact that 37% of the low-cost demographic do not use gas discount programs was rather surprising since students are naturally expected to take advantage of discounts. Perhaps many who reside on campus and drive very little assume the programs would yield minimal savings not worth the hurdles.

Secondly, the survey also showed a clear hierarchy of program utilization. Grocery shopping points were the most popular, followed by wholesale club memberships, then gas station loyalty programs, and in last place third party applications with a mere 8.7% usage. Hierarchy aside, however, it was clear that different individuals use different programs, thus further providing a

basis for our analysis and research objectives. Would the hierarchy hold up, and should some consumers reevaluate and consider switching programs to save more? Section III.B covers how gas price and discount data for the programs was collected.

B. Gas Discount Programs Data Collection

Beginning from the central location, the CCU campus in Lakewood, we determined a radius of 6.7 miles based on the gas station and program that was furthest away, which was a Costco Wholesale club gas station. This meant all discount programs that are readily accessible within the 6.7-mile radius would be of research interest. We maintained the same four categories of programs: wholesale club member prices, grocery shopping points, gas station loyalty rewards, and third-party mobile applications. We recorded gas prices and cashback offers daily between September 9th and December 4th, 2022.

For wholesale clubs, the options were Costco and Sam's club. However, because the nearest Sam's club fuel center was 15.5 miles from the central location, we settled for Costco. We used the GasBuddy (2022a) platform, which crowdsources gas prices displayed at the pump to record prices for regular and premium gas (Costco does not offer midgrade).[3] Annual fees remained at $60 for its base membership, Gold Star, during the study period.

For the grocery shopping program, we included both Safeway rewards, and Kroger fuel points earned from King Soopers. Both have two gas stations within 3.5 miles of the central location. We recorded prices for regular, midgrade, and premium gas using Google's mobile map application Waze, which also crowdsources gas price data. We would have preferred to use Waze to also record Costco gas prices for consistency, but the application was not listing any Costco gas stations perhaps because none were in close proximity. Regardless, since both use crowdsourcing, there was no reason to think one source is better than the other.

For gas station loyalty programs, we focused on Shell Fuel Rewards because it is possible to apply points to earn additional savings in two ways. First, each dollar spent on groceries at the Kroger family of stores including King Soopers earns one fuel point, and every 100 points can be redeemed for 10 cents off per gallon at participating shell gas stations (Kroger Co., 2023). The discount can be added to other Shell fuel rewards, however during our field interviews, managers at two shell stations within 3 miles of our central location informed us that this combination of shell rewards and Kroger points could only achieve a maximum of 30 cents off per gallon.

The second way to earn points is on qualifying purchases such as dining at participating restaurants, shopping specific brands online, buying select items in the Shell gas station store, event tickets and car rentals using a registered payment card (Fuel Rewards, 2022). The fuel rewards that accumulate can lead to major savings since there is no limit on the discount, meaning even $3 off per gallon discount can be achieved, off a gas price of say $3.80 per gallon, but up to a maximum 20 gallons per purchase per vehicle. However, these

[3] Crowdsourcing involves obtaining information from a large group of people who submit their data via the internet, social media and smartphone apps (Hargrave, 2022). In this case, this means this data comes from multiple individuals who submit gas price data as spotted at the pump, or self-reported prices by station owners and attendants.

spending categories that qualify for rewards are quite specific, and very few people hardly spend a lot of money shopping in gas station stores. Neither is it common for the average American to frequently make qualifying purchases such as renting a vehicle. Perhaps dining out and online shopping can be significant, but only select restaurants and brands qualify when consumers use affiliate marketing links on the Fuel Rewards site (Fuel Rewards, 2023). With some additional work, this program can be worth it for someone who spends a lot within the network of Shell and its partners. However, this does not reflect the typical American consumer nor the study population. Because such spending would also vary widely between individuals and households, there was no objective way to determine the discount that the average consumer can expect to get at Shell gas stations beyond the base 5 cents off as a gold status member. This status must also be maintained by making at least six 5-gallon purchases every 3 months, failure to which you drop to the silver tier which offers 3 cents off.

Shell fuel rewards can also be combined with Kroger fuel points, however, according to the King Soopers (2023) fuel program FAQs, only 100 points can be redeemed for 10 cents off per gallon at participating Shell locations even if you had, say, 800 points, which would get you 80 cents off at gas stations operated by Kroger itself.

Another attractive loyalty program is by Sinclair, but its 10 and 20 cents off per gallon limited time offers and at participating locations only can be inconvenient (Sinclair, 2022). When all factors are considered, other programs offer more from the base level. For example, third party applications listed gas stations with similar pump prices, but consistently offered larger discounts. Ultimately, we decided to drop the Shell fuel rewards and other similar station loyalty programs from our study.[4]

For the third-party applications, the competition was ultimately between GasBuddy and Upside. GasBuddy requires a zip code and a phone's location services to start showing the lowest price nearby. However, the GasBuddy application requires a user to request a credit card or debit card that must be linked to a checking account to pay the discount price up to 25 cents off per gallon (GasBuddy, 2022b). On the other hand, Upside does not require a specific payment card. A user simply needs to register any existing credit or debit cards in the app (Upside, 2022). Cashback offers in the app depend on the gas station and fuel grade but can exceed 40 cents off per gallon.[5] We therefore settled on Upside as the more convenient application with potentially larger savings. We recorded daily gas price and cashback offers for all fuel grades from all stations within the radius as were offered in the application.

Thus overall, we analyzed three alternatives: wholesale club member prices at Costco, Grocery shopping points from King Soopers and Safeway, and the third-party mobile application Upside. Note, though few, there are other 'unpopular' or 'no brand' stations within the radius that fell outside the scope

[4] Including Circle K's *Inner Circle Rewards* (Circle K, 2024), 7-Eleven *7Rewards* (7-Eleven, 2023), Exxon Mobil's *Rewards+* (Exxon Mobil, 2022), and Sinclair's *DinoPay* App or *Mobile Advantage* account (Sinclair, 2022).

[5] The appendix shows screenshots of cashback offers in the Upside app during the study period in two States, Boise in Idaho and Aurora in Colorado on October 29th, 2022. Note, our user experience suggested users should not expect to consistently see such high cashback offers that exceed 40 cents off. Our computed averages were much lower.

our research since we could not view current prices or discounts online before heading out to the station. We do not feel that this yields any significant shortcomings, moreover the third-party application Upside lists a variety of gas stations of different brands. Thus, put together, these three categories offer consumers numerous options as shown in the results and discussion that follows.

IV. Analysis Results and Recommendations

This section presents an analysis of the collected data and applicable discounts. According to several studies, the average American family uses about 40 to 50 gallons per month per registered vehicle.[6] We thus used 45 gallons as the average for our comparative analysis to make objective recommendations for the typical American consumer.

A. Wholesale Club Member Prices: Costco

Costco's base annual membership fee of $60 converts to $5 a month. To make pump price comparisons, we computed this fee into a per gallon cost by dividing it by 15 gallons, the typical size of a gas tank for one fill a month, by 30 gallons for two fills a month, by 45 for three fills and so on.[7] We then added this additional cost to the average gas price we computed from the gas prices recorded over the study period. This computation basically gives us what we have termed the effective price. The last two columns of table 2 show what the effective price was for someone who fills up once, twice, up to ten times, or buys 15 to 150 gallons a month.

Table 2: Effective price of gasoline on a Costco membership

				Pump Price Average	
Station	**Location**	**Distance**	**Member fees (per month)**	**Regular**	**Premium**
Costco	7900 W Quincy Ave	6.1 miles	$5.00	$3.16	$3.71
No. of times filling gas	Gallons per month		Additional cost per. gal	**Effective Price**	**Effective Price**
1	15		$0.33	$3.49	$4.04
2	30		$0.17	$3.33	$3.88
3	45		$0.11	$3.27	$3.82
4	60		$0.08	$3.24	$3.79
5	75		$0.07	$3.23	$3.78
6	90		$0.06	$3.22	$3.77
7	105		$0.05	$3.21	$3.76
8	120		$0.04	$3.20	$3.75
9	135		$0.04	$3.20	$3.75
10	150		$0.03	$3.19	$3.74

For the average American, 45 gallons per month would have cost $1,706.40 for regular gas, plus $60 membership fee to total $1,766.40 per year, and total $2,063.40 for premium gas a year. We set this as the benchmark for comparison with the other programs. Note that we did not need to consider the additional 4% cashback that

[6] See Hudson and Smith (2021). Other authors also confirm 40 - 50 gallons of gasoline consumption a month for the average American family; Hawley (2023), and Lem Smith (2022), vice president at American Petroleum Institute.

[7] Most car reviewers and literature state that on average most small cars have 12-gallon gas tanks, most sedans about 15-gallons, and SUVs about 22-gallons. We chose the median, 15-gallons as the typical gasoline tank capacity.

Costco members with a Citi bank visa card can earn on gas purchases, since the same 4% can be earned on eligible gas purchases at other gas stations, not just at Costco. Moreover, the cashback earned is restricted to shopping at Costco only.

B. Grocery Store Shopping Points

Two grocery stores, King Soopers (part of the Kroger family of stores) and Safeway each have two gas stations within 3.5 miles of the central location. Both run fuel points programs that operate much the same way. One fuel point is earned for every $1 spent on most grocery items with few exceptions.[8] Kroger store customers can redeem points in 100 point increments up to 1,000 points at a time which equates to $1 off per gallon, for up to 35 gallons at King Soopers gas stations (King Soopers, 2023). Thereafter. The regular pump price applies. Safeway customers can use points to fill up to 25 gallons (Safeway, 2023), which is 10 gallons less than King Soopers. A user can also split and use the points in chunks, i.e., 30 cents off on three separate fill-ups for 900 points total in that month.

Kroger fuel points expire the last day of the month after they are earned, i.e., fuel points earned in February expire on March 31st, and monthly balances do not combine across months (King Soopers, 2023). For Safeway, any points less than the 100-point increments expire at the end of each month, and the rest the following month. For example, if 225 points are earned in April, 25 points would expire at 1:00 am local time on May 1st, and the remaining 200 points would automatically convert to 2 rewards that would be available for use until they expire at 1:00 am on June 1st (Safeway, 2023).

Tables 3 and 4 show the results of the two King Soopers and Safeway gas stations respectively that had the lowest average of the recorded gas prices. To compute the effective price, we subtracted from the average gas price, the equivalent discount that would be applied from points earned from one month's grocery shopping.

Table 3: Effective Price of Gasoline Using Kroger Fuel Points at King Soopers

			Pump Price Average		
Station	**Location**	**Distance**	**Regular**	**Midgrade**	**Premium**
King Soopers	198 S Union Blvd	2.3 miles	3.42	3.63	4.05
Grocery costs	Grocery points	Discount	**Effective Price**	**Effective Price**	**Effective Price**
$100	100	$0.10	$3.32	$3.53	$3.95
$200	200	$0.20	$3.22	$3.43	$3.85
$300	300	$0.30	$3.12	$3.33	$3.75
$400	400	$0.40	$3.02	$3.23	$3.65
$500	500	$0.50	$2.92	$3.13	$3.55
$600	600	$0.60	$2.82	$3.03	$3.45
$700	700	$0.70	$2.72	$2.93	$3.35
$800	800	$0.80	$2.62	$2.83	$3.25
$900	900	$0.90	$2.52	$2.73	$3.15
$1,000	1000	$1.00	$2.42	$2.63	$3.05

[8] Excludes alcohol, tobacco products, fuel, money orders, taxes, postage stamps, lottery, promotional tickets, CRV, Prescriptions and guest or customer services/fees. Void where taxed, prohibited or restricted by law. Must use rewards card or Shopper's card to earn reward (King Soopers, 2023). Note that on some occasions, consumers can benefit even more from promos that 2× and 4× fuel points for every $1 spent on eligible items and gift cards.

Table 4: Effective Price of Gasoline Using Safeway Rewards

			Pump Price Average		
Station	**Location**	**Distance**	**Regular**	**Midgrade**	**Premium**
Safeway	9160 W Colfax Ave	2.4 miles	3.44	3.64	3.91
Grocery costs	Rewards	Discount	**Effective Price**	**Effective Price**	**Effective Price**
$100	1	$0.10	$3.34	$3.54	$3.81
$200	2	$0.20	$3.24	$3.44	$3.71
$300	3	$0.30	$3.14	$3.34	$3.61
$400	4	$0.40	$3.04	$3.24	$3.51
$500	5	$0.50	$2.94	$3.14	$3.41
$600	6	$0.60	$2.84	$3.04	$3.31
$700	7	$0.70	$2.74	$2.94	$3.21
$800	8	$0.80	$2.64	$2.84	$3.11
$900	9	$0.90	$2.54	$2.74	$3.01
$1,000	10	$1.00	$2.44	$2.64	$2.91

The results suggest that premium gas is on average cheaper at Safeway, but there is little difference in regular and midgrade gas. Still, between the two, we recommend King Soopers as it is slightly cheaper, slightly closer, and offers 10 gallons more per discount applied – 35 gallons maximum versus 25 gallons at Safeway – which is particularly useful for large SUVs and trucks. Furthermore, unlike Safeway rewards points, Kroger points less than the 100-point increment do not expire before they are used on the first day of the new month.

Based on the King Soopers data, without discounts, it would cost an average American who buys 45 gallons per month about $1,846.80 for regular gas a year, $1,960.20 for midgrade, or $2,187 for premium gas ($2,111.40 at Safeway). This is about $80 more than it would cost for regular gas at Costco, and $123.60 more for premium gas ($48 more at Safeway). Note the additional cost at King Soopers for both fuel grades exceed the $60 annual membership fee. This implies if an average American does not intend to use Kroger fuel points to get discounts on gas, they might as well get a Costco membership even if it's for the sole purpose of saving on gas, contingent on distance and convenience of course.

For example, a low consumption of 20 gallons regular gas a month would have cost $758.40 for the year, plus the $60 membership fee totals $818.40 a year at Costco. Comparatively, without using fuel point discounts and paying the pump price, 20 gallons a month would have cost $820.80 a year, $2 more at King Soopers. This also means 20 gallons a month is just about the threshold, below which a Costco membership for gas savings alone would not be worth the savings. For premium gas, that threshold is 15 gallons a month, which would cost $667.80 plus $60 membership fees totals $727.80 a year at Costco, versus $729.00 a year at King Soopers. Therefore, King Soopers and Safeway customers who do not use fuel points for discounts are better off paying the $60 membership fee and buying gas at Costco if and only if they buy more

than 20 and 15 gallons of regular and premium gas respectively per month.[9]

On the flipside, however, if the consumer spends at least $300 a month on groceries at King Soopers and applies the 30 cents off discount on the maximum 35 gallons and buys the remaining 10 gallons at the regular pump price, the total cost would be $1,310.40 for 35 gallons and $410.40 for 10 gallons, total $1,720.80 per year on regular gas. Comparatively, this is $45 less than the $1,766.40 per year at Costco. Likewise, for premium gas, 35 gallons with 30 cents off per gallon would cost $1,575.00, plus $486.00 for 10 gallons at pump price totals $2,061.00 per year at King Soopers. Comparatively, this is $2 less than the $2,063.40 it would cost an average American at Costco. This means, based on the study period data, if an individual already shops or would consider shopping at King Soopers, a $300 monthly grocery bill is the minimum threshold to save more on gas by filling up at King Soopers rather than at Costco (if membership cost is included).

Consequently, the per capita personal consumption expenditure on food and non-alcoholic beverages for off-premises consumption in Colorado was $279.71 a month in 2021, which is close to the $300 threshold.[10] Likewise, our survey showed that 86.4% of consumers in the high-cost group spend more than $300 a month on groceries. Utilizing points at King Soopers or Safeway just might be best for many, unless a Costco membership must be had for reasons besides gas.

On the other hand, only 6.3% in the low-cost group of students spend $300 or more a month on groceries. This means for 94% of them, a Costco subscription would have helped save more on gas than King Soopers in 2022, if they bought monthly at least 20 or 15 gallons of regular or premium gas respectively. Our survey showed that 80.5% of students buy 15 gallons or more.

We also recognize that some consumers shop both at Costco and King Soopers. This does mean that there might be occasions where one should consider going to fill up at King Soopers, against the natural inclination to go where gas is "always cheaper," Costco. Our results show that during our study period, the average price of regular gas at Costco was 26 cents cheaper than at King Soopers ($3.42 - $3.16), and for premium gas, 34 cents cheaper ($4.05 - $3.71). This means, on average, if at any given moment a consumer had 300 or 400 points, choosing to fill up at King Soopers was generally cheaper for regular and premium gas respectively.

C. Third Party Cashback Applications: Upside

Founded in 2015 as a pilot in Washington D.C. by two former Google employees, Upside uses geo-location to pull up a map and list cashback offers from participating gas stations (as well as restaurants and grocery stores). Upside's algorithms comb through

[9] For those who buy less than 20 and 15 gallons per month of regular and premium gas respectively, buying Costco gas makes sense if the membership fee is an irrelevant cost for some reason – such as being a member is for reasons other than gas e.g. buying merchandise in bulk, or membership fees are shared with others, or are zero as would be the case, say, when a student is using their parents' membership.

[10] Personal consumption expenditure: food and non-alcoholic beverages purchased for off premises consumption was $19,505.4 million for Colorado in 2021 (U.S. Bureau of Economic Analysis, 2022). Colorado 2021 population as of July 1st was 5,811,297 (U.S. Census Bureau, 2022). We used these statistics to compute $3,356.46 per capita per year, or $279.71 per person per month.

anonymized data such as location, timestamps, and ticket sizes to understand how customers behave, machine learning then crafts personalized incentives (Upside, 2023). In short, the app uses user data and machine learning to calculate what basically amounts to personalized cashback offers for each customer (Varner & Kerr, 2022). This means, unlike traditional loyalty programs, no two users may necessarily have the same offers. This would present a problem for our analysis, however, because we use an average of all the recorded cashback offers, we are confident that users can expect similar averages.

Offers are valid for the first 50 gallons of gas purchased. In our user experience, Upside listed offers from 21 gas stations all within the 6.7-mile radius, however, we report only 18 below that had consistent offers during the study period. Tables 5, 6, and 7 show the highest, lowest, and the average of all the cashback offers recorded for each station and gas grade. To compute the effective price, we subtracted the average cashback from the average gas price for each station. We then ranked them, the first being the station with the lowest effective price. We did this for each grade.

Table 5: Effective price using the cashback application Upside – Regular gas

				Regular				
Rank	**Station**	**Location**	**Distance (miles)**	**Highest c/b offer**	**Lowest c/b offer**	**Average c/b offer**	**Average gas price**	**Effective price**
1	Circle K	722 S Kipling St	1.9	$0.24	$0.01	$0.08	$3.28	**$3.20**
2	Circle K	1890 Wadsworth Blvd	3.1	$0.26	$0.01	$0.08	$3.34	**$3.26**
3	Circle K	9207 W Jewell Ave	2.4	$0.34	$0.01	$0.13	$3.41	**$3.28**
4	Conoco	10815 W Jewell Ave	3.3	$0.28	$0.01	$0.06	$3.37	**$3.31**
5	Phillips 66	12851 W 32nd Ave	6.3	$0.33	$0.01	$0.08	$3.41	**$3.33**
6	Conoco	7603 W 13th Ave	2.8	$0.27	$0.01	$0.06	$3.40	**$3.34**
7	Conoco	3440 S Wadsworth Blvd	4.7	$0.31	$0.01	$0.09	$3.43	**$3.34**
8	Valero	6601 W 44th Ave	5.8	$0.29	$0.01	$0.08	$3.42	**$3.34**
9	Conoco	3103 S Sheridan Blvd	6.0	$0.29	$0.01	$0.08	$3.44	**$3.36**
10	Circle K	4797 S Wadsworth Way	6.3	$0.29	$0.01	$0.09	$3.48	**$3.39**
11	Conoco	9999 W 38th Ave	4.9	$0.28	$0.01	$0.08	$3.50	**$3.42**
12	Phillips 66	289 S. Garrison	0.5	$0.24	$0.01	$0.05	$3.47	**$3.42**
13	Conoco	1110 S Pierce St	2.3	$0.28	$0.01	$0.09	$3.53	**$3.44**
14	Circle K	3805 Kipling St	5.0	$0.26	$0.00	$0.06	$3.51	**$3.45**
15	Phillips 66	4750 Kipling Street	5.9	$0.33	$0.00	$0.11	$3.62	**$3.51**
16	Circle K	2900 S Bear Creek Blvd	5.8	$0.31	$0.04	$0.12	$3.66	**$3.54**
17	Circle K	1155 S Wadsworth	1.8	$0.35	$0.03	$0.12	$3.82	**$3.70**
18	Circle K	15065 W Colfax Ave	5.4	$0.42	$0.03	$0.13	$3.87	**$3.74**

c/b = cashback

Circle K at 722 South Kipling Street had both the lowest average price and effective price for regular gas. Accordingly, the average American who consumes 45 gallons a month would have expected regular gas to cost $1,728.00 for the year using Upside, about $38 less than the $1,766.40 at Costco (includes the $60 membership fee), and about $119 less than $1,846.80 at King Soopers (without fuel point discounts applied). The immediate implication of this result is that for low-cost demographics such as singles or students who do not need Costco, and spend

little on groceries, the third-party application Upside would have yielded the most savings. Indeed, 83% of the students surveyed indicated they spend $200 or less on groceries per month, and 79% buy regular gas. Upside is thus also best for consumers below the 20-gallon threshold of regular gas per month.

Table 6: Effective price using the cashback application Upside – Midgrade gas

				Midgrade				
Rank	**Station**	**Location**	**Distance (miles)**	**Highest c/b offer**	**Lowest c/b offer**	**Average c/b offer**	**Average gas price**	**Effective price**
1	Phillips 66	4750 Kipling Street	5.9	$0.35	$0.01	$0.13	$3.72	**$3.59**
2	Valero	6601 W 44th Ave	5.8	$0.29	$0.03	$0.10	$3.74	**$3.64**
3	Conoco	10815 W Jewell Ave	3.3	$0.30	$0.03	$0.11	$3.77	**$3.66**
4	Circle K	722 S Kipling St	1.9	$0.30	$0.03	$0.11	$3.78	**$3.67**
5	Conoco	7603 W 13th Ave	2.8	$0.35	$0.02	$0.12	$3.80	**$3.68**
6	Conoco	9999 W 38th Ave	4.9	$0.32	$0.03	$0.10	$3.80	**$3.70**
7	Phillips 66	289 S. Garrison	0.5	$0.24	$0.03	$0.06	$3.77	**$3.71**
8	Phillips 66	12851 W 32nd Ave	6.3	$0.30	$0.03	$0.10	$3.81	**$3.71**
9	Conoco	3440 S Wadsworth Blvd	4.7	$0.32	$0.03	$0.11	$3.82	**$3.71**
10	Circle K	1890 Wadsworth Blvd	3.1	$0.30	$0.03	$0.11	$3.84	**$3.73**
11	Conoco	3103 S Sheridan Blvd	6.0	$0.33	$0.03	$0.10	$3.84	**$3.74**
12	Circle K	9207 W Jewell Ave	2.4	$0.40	$0.10	$0.17	$3.91	**$3.74**
13	Conoco	1110 S Pierce St	2.3	$0.39	$0.03	$0.11	$3.93	**$3.82**
14	Circle K	4797 S Wadsworth Way	6.3	$0.29	$0.03	$0.13	$3.98	**$3.85**
15	Circle K	3805 Kipling St	5.0	$0.50	$0.01	$0.08	$4.01	**$3.93**
16	Circle K	2900 S Bear Creek Blvd	5.8	$0.43	$0.04	$0.14	$4.16	**$4.02**
17	Circle K	1155 S Wadsworth	1.8	$0.33	$0.03	$0.14	$4.32	**$4.18**
18	Circle K	15065 W Colfax Ave	5.4	$0.43	$0.03	$0.14	$4.37	**$4.23**

c/b = cashback

For midgrade gas, Phillips 66 at 4750 Kipling Street ranked first, 45 gallons would have cost $1,938.60 for the year, about $22 less than $1,960.20 at King Soopers (no discounts applied). Again, this suggests the third-party application Upside would have yielded more savings. Note that a like-to-like comparison to Costco could not be made since it does not offer midgrade.

Table 7: Effective price using the cashback application Upside – Premium gas

				Premium				
Rank	**Station**	**Location**	**Distance (miles)**	**Highest c/b offer**	**Lowest c/b offer**	**Average c/b offer**	**Average gas price**	**Effective price**
1	Circle K	722 S Kipling St	1.9	$0.31	$0.00	$0.10	$4.05	**$3.95**
2	Valero	6601 W 44th Ave	5.8	$0.30	$0.03	$0.10	$4.06	**$3.96**
3	Phillips 66	4750 Kipling Street	5.9	$0.43	$0.01	$0.12	$4.09	**$3.97**
4	Conoco	9999 W 38th Ave	4.9	$0.32	$0.04	$0.11	$4.10	**$3.99**
5	Circle K	9207 W Jewell Ave	2.4	$0.42	$0.11	$0.18	$4.18	**$4.00**
6	Circle K	1890 Wadsworth Blvd	3.1	$0.32	$0.01	$0.11	$4.12	**$4.01**
7	Phillips 66	289 S. Garrison	0.5	$0.24	$0.03	$0.06	$4.07	**$4.01**
8	Conoco	7603 W 13th Ave	2.8	$0.34	$0.04	$0.13	$4.20	**$4.07**
9	Conoco	10815 W Jewell Ave	3.3	$0.30	$0.03	$0.11	$4.18	**$4.07**
10	Phillips 66	12851 W 32nd Ave	6.3	$0.36	$0.03	$0.12	$4.21	**$4.09**
11	Conoco	3103 S Sheridan Blvd	6.0	$0.42	$0.04	$0.13	$4.24	**$4.11**
12	Circle K	4797 S Wadsworth Way	6.3	$0.38	$0.03	$0.13	$4.25	**$4.12**
13	Conoco	3440 S Wadsworth Blvd	4.7	$0.27	$0.03	$0.11	$4.23	**$4.12**
14	Conoco	1110 S Pierce St	2.3	$0.43	$0.03	$0.14	$4.33	**$4.19**
15	Circle K	3805 Kipling St	5.0	$0.30	$0.02	$0.08	$4.30	**$4.22**
16	Circle K	2900 S Bear Creek Blvd	5.8	$0.43	$0.04	$0.15	$4.46	**$4.31**
17	Circle K	1155 S Wadsworth	1.8	$0.43	$0.04	$0.15	$4.60	**$4.45**
18	Circle K	15065 W Colfax Ave	5.4	$0.39	$0.06	$0.16	$4.64	**$4.48**

c/b = cashback

Finally, for premium gas, Circle K at 722 South Kipling Street ranked top again, as it did for regular gas, with both the lowest average and effective price. Accordingly, the average American who consumes 45 gallons a month would have expected premium gas to cost $2,079.00 for the year using Upside, which is $108 less than $2,187.00 at King Soopers, and $32.40 less than $2,111.40 at Safeway (without fuel point discounts applied). Unlike the regular gas result, however, this would have been about $15.60 more than $2,063.40 at Costco (includes the $60 membership fee). This implies that, all else being equal, premium gas consumers are best off filling up at Costco, even if it would mean paying the $60 membership fee solely for the cheaper premium gas. However, this is if and only if they buy 15 gallons or more a month.

Below the 15-gallon threshold, Costco is unseated by Upside. To illustrate, at Costco, 15 gallons of premium gas per month would have cost $727.80 (includes the $60 membership fee), $729 at King Soopers and $703.80 at Safeway (points discounts not applied), and $693 on Upside using the effective price with the average cashback applied.

D. Summary of Results

This section presents a way to summarize the results discussed above, by giving a framework of comparison to illustrate what an average American who buys 45 gallons a month would have expected to save (or lose). In this case, the benchmark for regular gas was Costco, it had the lowest average gas price of $3.16 per gallon, which would sum up to $1,766.40 inclusive of the $60 annual membership fee. For midgrade, it was King Soopers on 198 South Union Boulevard at $3.63 per gallon, or $1960.20 a year. For premium gas, it was again Costco at $3.71 per gallon, or $2,063.40 inclusive of the $60 membership fee. We used these as benchmarks for comparison.

Table 8: Summary of results based on 45 gallons per month consumption of regular gas

Program	Best Station	Avg. price *(Regular)*	Discounts	Effective price	Annual cost	Annual savings
Costco member	7900 W Quincy Ave. (6.1 miles)	$3.16	If $60 fee is included in gas cost	$3.27	$1,766.40*	-
			If $60 fee is not included in cost	$3.16	$1.706.40	-
Kroger points	198 S Union Blvd. (2.3 miles)	$3.42	Points discount not applied	$3.42	$1,846.80	-$80.40
			100 pts monthly discount applied	$3.32	$1,804.80□	-$38.40
			300 pts monthly discount applied	$3.12	$1,720.80□	$45.60
Safeway rewards	9160 W Colfax Ave. (2.4 miles)	$3.44	Points discount not applied	$3.44	$1,857.60	-$91.20
			100 pts monthly discount applied	$3.34	$1,827.60Δ	-$61.20
			300 pts monthly discount applied	$3.14	$1,767.60Δ	-$1.20
Upside App	Circle K, 722 S Kip. St. (1.9 miles)	$3.28	No cashback discounts applied	$3.28	$1,771.20	-$4.80
			8 cents off on average applied	$3.20	$1,728.00	$38.40

* Benchmark. Annual totals are compared to this benchmark to compute potential savings.
□ Kroger points discount is applied on 35 gallons maximum, remaining 10 calculated at average pump price.
Δ Safeway rewards discount is applied on 25 gallons maximum, remaining 20 calculated at average pump price.

For regular gas, Costco is the best overall if we exclude the $60 membership fee in cost of gas. Such would be the case for members who subscribe solely for in-store perks and not gas, or do not bear the costs themselves, such as a student on their parents' membership. However, if circumstances are such that the membership cost be included in the cost of gas, then Costco cedes the pole position to Upside for regular gas. On average, Upside would save $38.40 more on regular gas than at Costco having applied the average cashback of 8 cents off. Utilizing fuel points at King Soopers would save $45.6 if and only if the consumer spends at least $300 a month on groceries.

Table 9: Summary of results based on 45 gallons per month consumption of midgrade gas

Program	Best Station	Avg. price *(Midgrade)*	Discounts	Effective price	Annual cost	Annual savings
Kroger points	198 S Union Blvd. (2.3 miles)	$3.63	Points discount not applied	$3.63	$1,960.20*	-
			100 pts monthly discount applied	$3.53	$1,918.20□	$42.00
			300 pts monthly discount applied	$3.33	$1,834.20□	$126.00
Safeway rewards	9160 W Colfax Ave. (2.4 miles)	$3.64	Points discount not applied	$3.64	$1,965.60	-$5.40
			100 pts monthly discount applied	$3.54	$1,935.60Δ	$24.60
			300 pts monthly discount applied	$3.34	$1,875.60Δ	$84.60
Upside App	Phillips 66, 4750 Kip. St (5.9 miles)	$3.72	No cashback discount applied	$3.72	$2008.80	-$48.60
			13 cents off on average applied	$3.59	$1,938.60	$21.60

* Benchmark. Annual totals are compared to this benchmark to compute potential savings.
□ Kroger points discount is applied on 35 gallons maximum, remaining 10 calculated at average pump price.
Δ Safeway rewards discount is applied on 25 gallons maximum, remaining 20 calculated at average pump price.

For midgrade, the King Soopers station at 198 S Union Blvd. ranks first since it has the lowest average pump price when no points, discounts, or cashbacks are applied. Thus, based on our data, the only situation where the average consumer would save more using the available alternative Upside, is if the consumer does not shop at King Soopers or

utilize points. In that case, Upside would on average save $21.60 on midgrade gas having applied the average 13 cents per gallon cashback. Since Costco does not offer midgrade, we could not compare it to other programs.

Table 10: Summary of results based on 45 gallons per month consumption of premium gas

Program	Best Station	Avg. price *(Premium)*	Discounts	Effective price	Annual cost	Annual savings
Costco member	7900 W Quincy Ave. (6.1 miles)	$3.71	If $60 fee is included in gas cost	$3.82	$2,063.40*	-
			If $60 fee is not included in cost	$3.71	$2,003.40	-
Kroger points	198 S Union Blvd. (2.3 miles)	$4.05	Points discount not applied	$4.05	$2,187.00	-$123.60
			100 pts monthly discount applied	$3.95	$2,145.00□	-$81.60
			300 pts monthly discount applied	$3.75	$2,061.00□	$2.40
Safeway rewards	9160 W Colfax Ave. (2.4 miles)	$3.91	Points discount not applied	$3.91	$2,111.40	-$48.00
			100 pts monthly discount applied	$3.81	$2,081.40Δ	-$18.00
			300 pts monthly discount applied	$3.61	$2,021.40Δ	$42.00
Upside App	Circle K, 722 S Kip. St. (1.9 miles)	$3.95	No cashback discounts applied	$3.95	$2,133.00	-$69.60
			10 cents off on average applied	$3.85	$2,079.00	-$15.60

* Benchmark. Annual totals are compared to this benchmark to compute potential savings.
□ Kroger points discount is applied on 35 gallons maximum, remaining 10 calculated at average pump price.
Δ Safeway rewards discount is applied on 25 gallons maximum, remaining 20 calculated at average pump price.

Finally, for premium gas, Costco was again the overall clear winner if we exclude the $60 membership fee in cost of gas. Even if we include it, however, the only way it can cede its rank to grocery fuel points is if and only if the consumer spends $300 or more at King Soopers or Safeway to apply a discount of at least 30 cents per gallon off premium gas. Likewise, the only way Costco can cede its lead to the third-party app Upside, is if the consumer buys less than 20 gallons of premium gas a month. Outside of this, these results suggest it would be worthwhile to subscribe to the membership and pay the $60 fee even if it is for the sole purpose of cheaper premium gas.

V. Conclusion

Skyrocketing gas prices as experienced in the months leading up to the peak in June 2022 warranted a re-evaluation of the means to save on gas. Besides traveling less and carpooling among others, there exist competing gas discount programs that help consumers to save. In this study, we identified such programs that can be grouped into four categories namely: wholesale club membership, grocery store fuel points, gas station loyalty rewards, and third-party mobile applications. Our survey of faculty, staff and students at the chosen central location, the Lakewood campus of Colorado Christian University, showed that respondents have different gas consumption and grocery expenditure levels as expected, as well as varying awareness and utilization of gas discount programs. We thus sought to investigate what program might yield the most savings for a high-spending or high-cost demographic such as large families, proxied by faculty and staff, and for a low-cost demographic such as singles proxied by students.

Most people presume Costco is the best since it offers the cheapest prices. This was indeed the a priori hypothesis we sought to test. This study has shown that this is only true if the

consumer's circumstance is such that they can disregard and not count the $60 membership fee in the cost of gas. Only in such a case is Costco the best overall. But there is one situation that can supersede this, if a consumer spends $300 or more at the grocery stores King Soopers or Safeway for 30 cents or more off per gallon. This applies for both the regular and premium grades of gas.

If the membership cost matters, however, things change. For regular gas, the average American consumer, as well as the high-cost group proxied by faculty and staff, and the low-cost group proxied by students, are all better off using the third-party app Upside with the applied average cash back of 8 cents off per gallon. For midgrade gas, again Upside with the average 13 cents off cashback applied edges grocery fuel points when no discounts are applied. For premium gas, Costco retakes the throne beating Upside with its average 10 cents off cashback offer applied.

In all three cases, without applying fuel points discounts and facing the raw pump price, grocery stations languish in third place. However, this changes when fuel points discounts are applied. For regular gas when the consumer spends $300 or more, King Soopers takes first place, relegating the other two. For midgrade, when the consumer spends $100 or more, both King Soopers and Safeway topple Upside, (Costco has no midgrade gas). For premium, when the consumer spends $300 or more, Safeway dethrones Costco. Ultimately, since up to 1,000 fuel points can be redeemed for $1 off per gallon, grocery points can potentially offer the most savings such that Costco and Upside don't even come close.

In sum, these results show that there isn't necessarily one overall winner like we and most expect. The analysis as illustrated in tables 8, 9, and 10 shows that what's best for the American average consumer of 45 gallons a month for example, ultimately depends on individual circumstances, likewise for those who buy lesser amounts such as below 20 gallons a month.

According to our survey, of the 72.7% who go to a specific gas station among the high-cost group, 30.7% fill up at Costco, 23% go to King Soopers, and 15.4% go to Safeway. We did not ask respondents why they make the choices they do as we anticipated that reasons might vary considerably. Whatever the case, the results from this study suggest that many may need to reassess their circumstances and reconsider their choices. This is perhaps true for 27.3% in the high-cost group and 51.1% in the low-cost group who do not go to any specific gas station. In addition, since 30% of those in the high-cost group, and 43.3% of those in the low-cost group check prices and go wherever is cheapest, this study has shown that a simple third-party application such as Upside is worthy to consider.

Overall, our study shows that an average American who buys about 45 gallons a month can avoid losing about $92 on regular gas, $49 on midgrade, and $124 on premium gas a year, and can save about $45 on regular gas, $126 on midgrade, and $41 on premium gas a year by utilizing gas discount programs. Even though these results are based on a time specific study, the results can still apply in future since gas prices at different stations within a limited geographical area tend to go up or down in proportion.[11] In a nutshell, this study has on one hand provided a framework

[11] Bergeaud and Raimbault's (2020) analysis of the spatial variability of fuel prices, which used 14,192,352 observations from 117,155 gas stations in the United States, seems to suggest such proportionate changes in gas prices across a geographical space (such as a county), and time.

that a consumer can use to examine their personal circumstances to gauge if the savings are worth the hurdles, and has on the other hand shown the potential to save tens to hundreds of dollars a year by utilizing a gas discount program. Whichever is best, of course, ultimately depends on individual circumstances with a host of factors whose significance vary in degree, and location, location, location.

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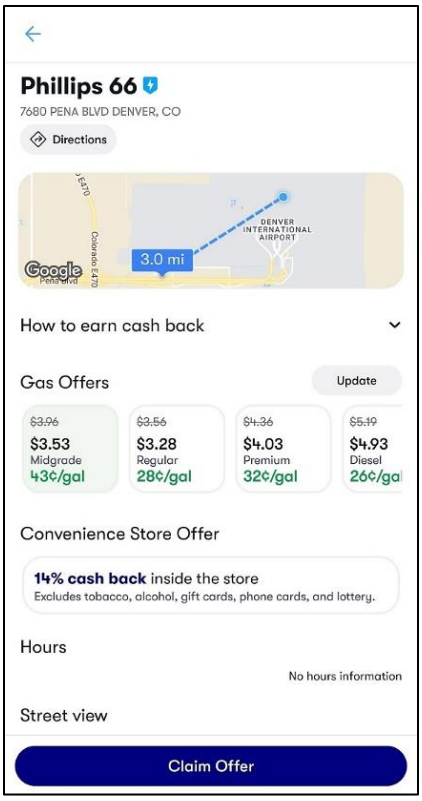
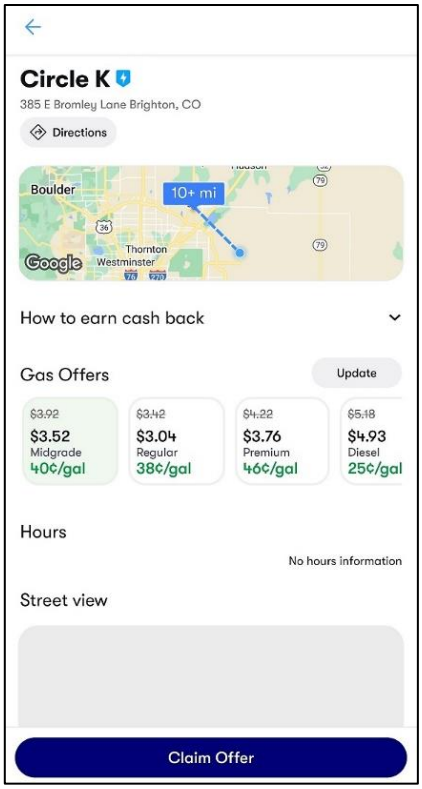
Appendix: Upside app screenshots of discounted prices from cashback offers in Colorado and Idaho in the Upside app on October 29th, 2022

Colorado





Idaho