

Carbon taxes and the affordability of gasoline

Results from the University of Michigan Energy Survey

September 2017

KEY FINDINGS

- ▶ Probing consumers' thresholds for "pain at the pump" enables us to quantify how a carbon tax would affect American consumers' feelings about the affordability of gasoline.
- ▶ The gasoline price that consumers say they would find unaffordable, in the sense of having to change how they travel or otherwise conduct their daily lives, has generally been more than \$5 per gallon over the nearly four years of survey data collected to date.
- ▶ Some consumers already consider gasoline to be unaffordable, a view that varies by household income and amounts to about 2% of consumers on average.
- ▶ A carbon tax of \$40 per ton, similar to some recent proposals, would add 36¢ to the price of a gallon of gasoline. Relative to a price of \$2.80 per gallon, it would increase to 7.5% the number of consumers who feel that gasoline is unaffordable.
- ▶ Such a carbon tax would push 14% of low-income, 7% of middle-income and 4% of high-income consumers into the zone where they feel that they would need to make changes in how they travel.
- ▶ Even with a \$40 per ton carbon tax, gasoline would remain affordable for over 90% of Americans. Targeted relief for low-income households could address the concerns of consumers most sensitive to higher fuel prices.

One of the options on the table as policymakers grapple with global warming is a carbon tax. Long a favorite solution of economists, a carbon tax puts an additional levy on sources of energy in proportion to the amount of carbon dioxide (CO₂) emitted when they are used.

Some environmentalists advocate a carbon tax and came close to having a call for carbon taxation added to the Democratic platform.¹ Companion carbon tax bills were introduced by pairs of Democrats in both the House and Senate.² Although none have passed, carbon taxes have been proposed in several states. In Canada, several provinces have a carbon tax and it is now being considered for implementation nationwide.³

The approach gained a new level of attention when some retired Republican leaders joined other public figures and several major corporations to form the Climate Leadership Council (CLC).⁴ They propose a carbon tax to replace regulation of CO₂ and other greenhouse gas (GHG) emissions and returning the tax revenues to the public through dividends.⁵

For a majority of Americans, a carbon tax would be felt most directly in the price of motor fuel. Gasoline and diesel fuel are already taxed to finance roads and other parts of the transportation system. Gas taxes vary by state; the national average is 46¢ per gallon counting both the 18.4¢ per gallon federal tax and state taxes, which range from 9¢ in Alaska to 59¢ in Pennsylvania and average 27¢ per gallon overall.⁶

A gallon of gasoline weighs 6.2 pounds and is about 86% carbon; when burned, the carbon in the fuel combines with oxygen from air to release nearly 20 pounds of CO₂. Taxing that CO₂ would affect the price of gasoline as shown in Figure 1. The direct effect on the pump price is proportional to the magnitude of the tax.⁷ For example, taxing CO₂ at \$40 per ton (the initial level proposed by the CLC) would increase the price of gasoline by 36¢ per gallon.⁸

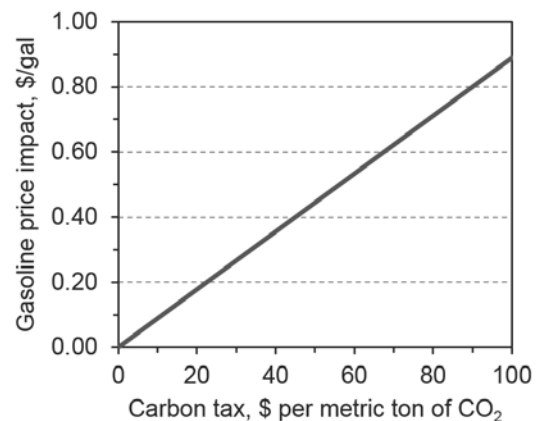


Figure 1. How a carbon tax directly affects the price of gasoline

A carbon tax would also have indirect price effects. Because CO₂ is emitted at petroleum refineries and electric power plants, a tax on those emissions would trickle down to the price of fuels and electricity. For electricity, which emits no CO₂ when used, the tax would fall on power companies according to the mix of fuels they use. Electricity from hydroelectric and nuclear power plants or carbon-free renewable resources such as wind and solar would not face a carbon tax. A utility that burns a lot of coal (the most carbon-intensive fossil fuel) would face higher carbon taxes than one that uses mostly natural gas (which is about half as carbon-intensive as coal). The resulting tax would be partly passed through to consumers in their electric bills depending on the mix of resources used by their local utility company as well as on market and regulatory factors. Similar indirect effects would raise the price of transportation fuels depending on the emissions during petroleum extraction, refining and distribution, as they would for any product or service whose supply entails CO₂ emissions. We don't analyze these indirect effects here, but they are something to keep in mind.

A number of surveys ask consumers for their opinions on gasoline or carbon taxes. For example, the National Survey on Energy and Environment (NSEE), run by the University of Michigan's Gerald Ford School of Public Policy and Muhlenberg College, recently found that 50% of Americans at least somewhat support a tax on carbon-based fuels as a way to reduce greenhouse gas (GHG) emissions.⁹

General views on the affordability of gasoline

The U-M Energy Survey does not ask consumers for their views on a carbon tax or any other public policy for that matter. Instead, we examine attitudes about energy

at a more basic level, including how people view the affordability of energy.¹⁰ We ask consumers to express their level of concern about the topic and also inquire about how much they believe they can afford to pay for energy compared to what they recently were paying. For gasoline, we ask:

At what price per gallon would gasoline get so high that it becomes unaffordable to you (and your family)?

To clarify what is meant by "unaffordable," we say it means a gasoline price so high that they and their household would have to make significant changes in the way they get around. When consumers replied that they felt that gasoline was already unaffordable, we asked them to tell us the price at which they felt it became unaffordable.

Figure 2 plots the responses to this question from the launch of the energy survey in fall 2013 through spring 2017. It shows the average gasoline price that consumers said they would find to be unaffordable in comparison to the national average gasoline price over the same period. The ratio between these two price levels is the basis for the gasoline affordability index that we report each quarter.¹¹

During the very first run of the U-M Energy Survey, in October 2013 when the national average price was \$3.42 per gallon,¹² consumers on average reported that gasoline would be unaffordable (in the sense noted above) if it reached \$5.70 per gallon. The price considered unaffordable then declined to \$4.76 per gallon by this past January. In the most recent data analyzed, taken in April when the national pump price was \$2.53 per gallon, the average price that consumers considered unaffordable bumped up to \$5.18 per

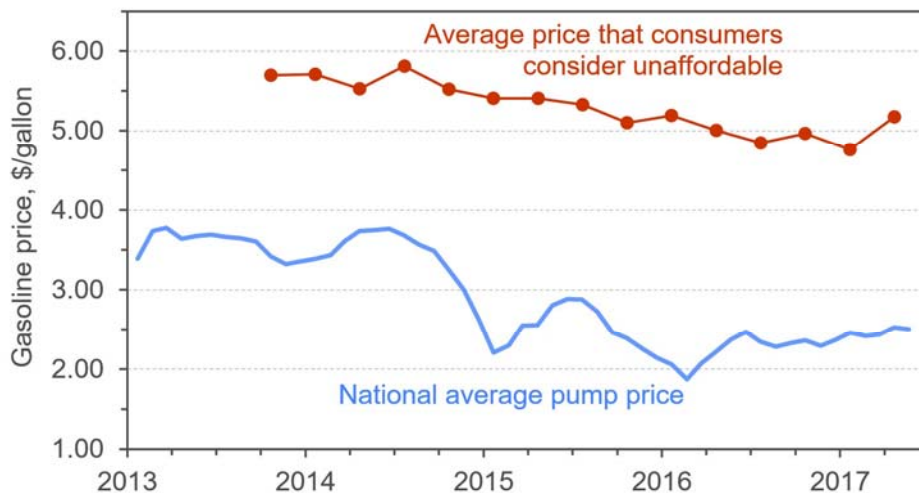


Figure 2. Comparison of the gasoline price that consumers say they would find unaffordable to national average pump prices

gallon. This notable rise in consumers' expressed threshold for pain at the pump may be related to the overall gains in consumer confidence seen since the beginning of 2017. In the first half of 2017, the Consumer Sentiment Index was higher than it had been in any other year since 2004.¹³ There were also highly favorable views of current economic conditions, which the U-M Surveys of Consumers associates with betterment of consumer personal finances.

Several other things are apparent in Figure 2. For one, the gap between actual gasoline prices and the level that consumers consider unaffordable is quite large. So there is room to raise taxes without putting the majority of consumers in the price zone where they would feel serious pain at the pump. Of course, that's not to say that American consumers would accept higher taxes without complaint (to put it mildly).

The chart also shows how the price considered unaffordable fell more gradually than the gasoline price itself. From an average of \$3.53 per gallon through summer 2014, the U.S. average pump price plunged to \$2.21 per gallon in January 2015. It then increased going into the summer before briefly dipping below \$2.00 in February 2016. The average retail gasoline price over the past year has been \$2.39 per gallon, more than a dollar less than it had been for several years prior to the oil price decline in 2014. The price that consumers consider unaffordable has not fallen as much. Its average of \$4.94 per gallon over the past year is 75¢ lower than the \$5.69 per gallon average seen during the first year of the survey.

Beneath these overall averages lies a wide range of individual views, which depend on household income and other factors. Figure 3 displays the distribution of the responses, plotting the percent of respondents who

say that gasoline would become unaffordable at a given price for the entire sample of 6,628 usable responses collected over the 15 quarters analyzed to date. Many consumers answer the question in round numbers, as seen by the jumps in the graph at specific dollar levels. For example, at \$4.00 per gallon, the number of respondents who say that gasoline would become unaffordable increases to 33%, compared to the 14% who named a price less than \$4.00. A large step occurs at the \$5.00 mark, a price where the number of consumers who say that gasoline would then become unaffordable more than doubles, reaching 68%.

Even before examining how feelings about the affordability of gasoline differ across income brackets, it is interesting to note the diverse views seen in the overall distribution. The national average gasoline price over the 15-quarter period was \$2.80 per gallon, a level that 2.2% of consumers consider unaffordable. A greater number of consumers saw gasoline as unaffordable when its price was higher. As recounted in the U-M Energy Survey's first-year report, for example, the fraction of respondents who felt that gasoline was already unaffordable was 5% when the national average pump price was \$3.57 per gallon.¹⁴

On the other hand, a number of consumers stated very high prices in response to the question. Nearly 10% said that gasoline would have to hit \$10 or more per gallon before they would find it unaffordable in terms of having to change their travel behavior. In fact, in almost every sample some consumers responded to the question by stating prices of \$50 per gallon and even \$95 or more per gallon. We interpret such responses as suggesting that some Americans feel strongly that they would not change their travel behavior no matter how high the price of fuel became.

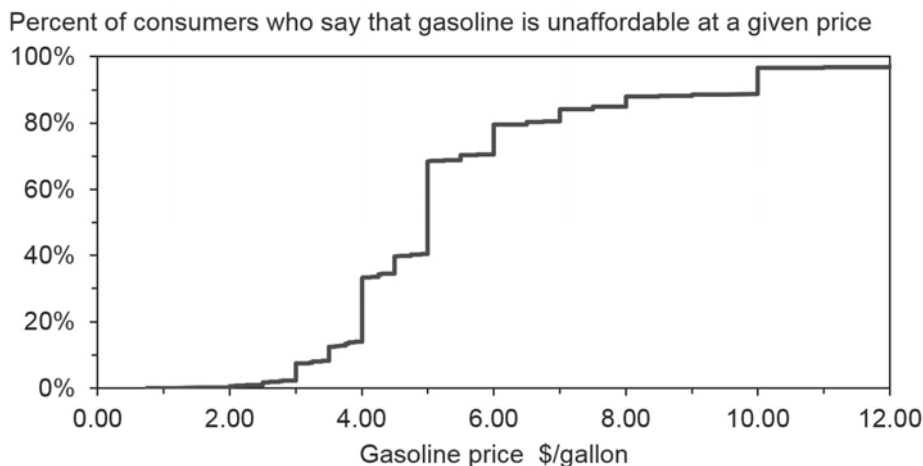


Figure 3. Overall distribution of responses to the question, "At what price per gallon would gasoline get so high that it becomes unaffordable?"
U-M Energy Survey quarterly samples Fall 2013 through Spring 2017; N = 6,628

Overall, the U-M Energy Survey responses are in line with the fact that the majority of Americans have little flexibility in terms of transportation. Most are very dependent on motor vehicles, and therefore on gasoline, a practical reality reflected in the economics of the situation. No ready method exists for mapping our survey's attitudinal responses to econometric findings on the topic. Nevertheless, the large gap between the actual pump price and the price considered unaffordable for most consumers is consistent with studies showing that gasoline demand is inelastic (meaning that fuel consumption responds weakly to changes in gasoline price), although studies differ regarding the degree of inelasticity.^{15,16}

How would fuel affordability be affected by a carbon tax?

Figure 4 zooms in on the lower end of the overall distribution shown in Figure 3. It shows how carbon taxes of various levels affect the number of consumers who feel that gasoline would become unaffordable. Taking the past 15 quarters' average of \$2.80 per gallon as the point of reference, a \$10 per ton tax on CO₂ would raise the price by about 9¢ (to \$2.89 per gallon). As seen by the dotted line labeled "\$10/tCO₂," such a carbon tax has little effect on the number of consumers who would find fuel to be unaffordable.

A \$10 per ton level is similar to the carbon price signal generated by some existing cap-and-trade regulations. Such policies set an overall limit on the amount of CO₂ and other greenhouse gases that can be emitted in a given year and issue a fixed number of emission permits ("allowances," measured in tons) accordingly. Companies subject to the policy can buy and sell the emission permits and the resulting trading price in dollars or euros per ton of CO₂ influences the price of energy or other goods and services that affect emissions.

In the European Emissions Trading System, carbon prices have been around €5 (about \$5.70) per ton over the past year.¹⁷ The California cap-and-trade program has recently seen carbon trading at around \$15 per ton.¹⁸ The more limited program of several eastern U.S. states known as the Regional Greenhouse Gas Initiative (RGGI) has resulted in only low carbon prices to date, generally well below \$10 per ton.¹⁹

A \$40 per ton carbon tax, the starting level proposed by the Climate Leadership Council, would raise gasoline prices by 36¢ per gallon. A somewhat higher level of \$49 per ton was proposed by Senator Sheldon Whitehouse and colleagues in recent bills. A noteworthy economic estimate puts the near-term damage cost of carbon at roughly \$50 per ton.²⁰ As seen in Figure 4, a \$40 per ton tax would push pump prices up to an average of \$3.16 per gallon relative to the reference level of \$2.80, crossing the \$3 threshold at

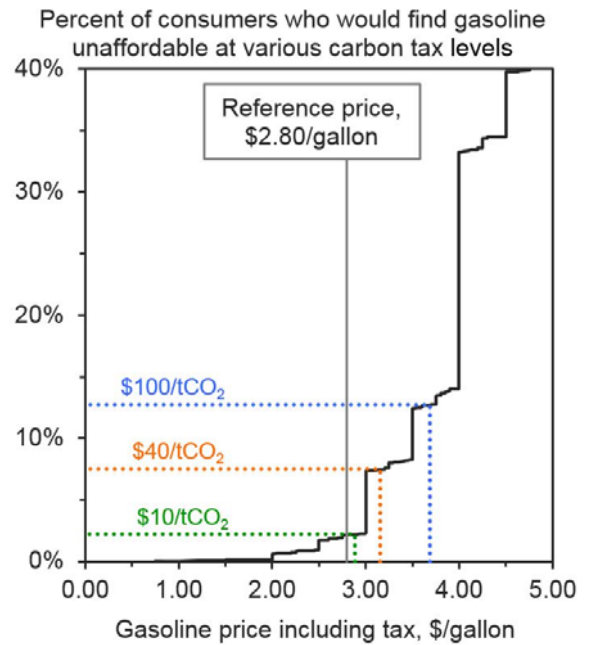


Figure 4. Distribution of gasoline prices that would be considered unaffordable with illustrative carbon tax levels

which there is a jump in the number of respondents who said they would then find gasoline to be unaffordable. Therefore, based on the distribution of energy survey responses to date, a \$40 per ton carbon tax would put the price of gasoline into a zone that 7.5% of consumers say they would find unaffordable in the sense of believing that they would have to change their travel-related behavior in some way.

Figure 4 also shows the impact of a \$100 per ton carbon tax, which would raise the price of gasoline by 89¢ per gallon. Some economists say that a tax of that magnitude is needed to avoid a climate disaster and cut emissions in line with deep reduction targets such as those put forth by the 2015 Paris climate accord.²¹ Again relative to a \$2.80 per gallon reference level, such a tax would push gasoline to \$3.69 per gallon, across the step in the distribution seen at \$3.50 per gallon and into a range that 13% of Americans said that they would find unaffordable.

It was not that long ago, of course, that gasoline prices were in such a range. For example, they averaged \$3.62 per gallon over the three-year period of Summer 2011 through Summer 2014. As we reported after launching the Energy Survey toward the end of that period, consumers were then much less happy with what they had to pay for fuel than they have been since then. The average gasoline affordability index was 62 based on survey responses at the time, or about half of what it has been more recently.²²

The data gathered in our survey do not reflect how views might shift if the carbon tax revenues were

returned to consumers in the form of dividends that would bolster household incomes. The NSEE data show that how the tax revenues are used significantly affects the level of support for a carbon tax.⁸ Interestingly, if the taxes are applied for deficit reduction, support drops. Conversely, support rises if the revenues are rebated back to consumers or used to fund renewable energy.

As described below (and as expected), feelings about the affordability of energy depend on consumers' incomes, with higher income consumers feeling that gasoline is more affordable than it is viewed by those in a lower income bracket. We surmise that, for any given carbon tax level, the number of people who view gasoline as unaffordable might be lower if they believed that the carbon tax revenues would be returned to them through dividends that compensate for the higher price of fuel by raising their income.

How views vary by consumer income

The U-M Surveys of Consumers ask respondents about their incomes and the resulting data enable us to examine how the impacts of a carbon tax would vary accordingly. To do so, we group our survey responses into thirds (terciles) of self-reported household income across the overall nationally representative sample.

Figure 5 plots the average responses to the question of how high the price of gasoline would have to become before it is seen as unaffordable by income. The responses are shown in comparison to the national average pump price, similar to what was shown in Figure 2, but now broken out by tercile of self-reported income. As expected, the top third of consumers by income generally report a higher threshold for pain at the pump than those in the lower terciles.

The gap between the gasoline price considered unaffordable by consumers in the higher income tercile compared to the others is almost always greater than the gap between the price estimates for the middle and lower terciles, which often have been quite similar. (The margin of error for these tercile breakouts is about 20¢ per gallon.) Over the 15 quarters of data gathered to date, the average gasoline prices considered unaffordable were \$4.86 per gallon for respondents in the lower tercile, \$5.20 for those in the middle tercile and \$5.82 for the upper income tercile. The average difference between middle and lower income responses was 34¢ per gallon while the average difference between middle and upper income responses was 62¢ per gallon. On average, upper income respondents said that they would not find gasoline to be unaffordable until it was nearly a dollar more per gallon than the threshold for lower income respondents.

Figure 6 shows the distribution of responses separately for each income tercile and how the number of consumers in each tercile pushed into the unaffordable zone would change with a \$40 per ton carbon tax. It is similar to Figure 4 except that the responses are broken out by income tercile and we show only the \$40 per ton level.

Applied on top of a reference fuel price of \$2.80 per gallon, that level of carbon tax would push the pump price to \$3.16 per gallon. At such a level, the different effects by income group are clear. Among respondents in the low income tercile, 14% would consider the price with the \$40 per ton tax unaffordable, compared to the 4.5% who find the reference price (\$2.80 per gallon) unaffordable. That's twice the number of middle income consumers [7%] who would find fuel

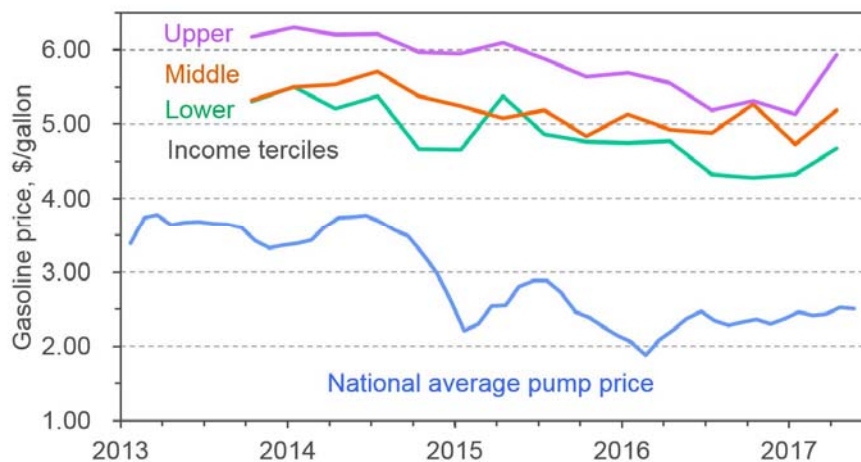


Figure 5. Gasoline prices considered unaffordable by tercile of self-reported household income compared to national average pump prices

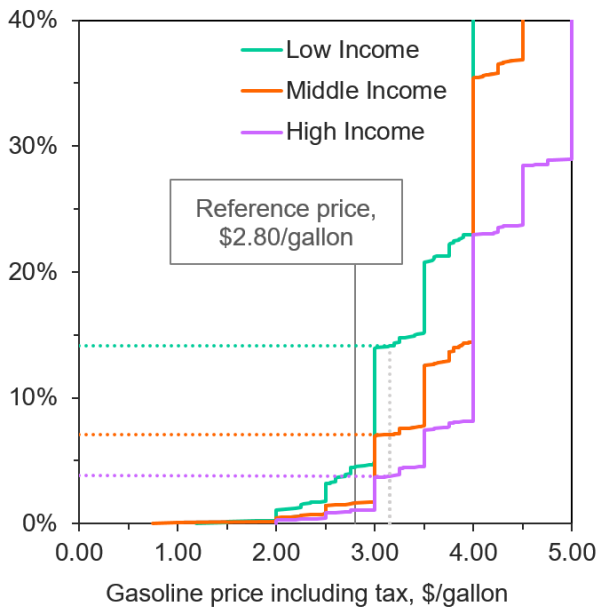


Figure 6. Fractions of consumers by income tercile who would find gasoline unaffordable if a \$40 per ton of CO₂ tax were applied on top of a \$2.80 per gallon reference price

unaffordable with a \$40 per ton carbon tax. The number of respondents who say that a pump price at the carbon-taxed level would be unaffordable drops by nearly half again for the high income tercile, in which only 4% of respondents felt that \$3.16 per gallon is too much to pay.

In contrast to the averages by income tercile shown in Figure 5, Figure 6 focuses on the consumers who express the most sensitivity about a rise in gasoline prices. This share of the population greatly increases moving down from the middle to the low income tercile. In contrast, the averages in Figure 5 are affected by the consumers who express a tolerance for very high

gasoline prices, namely, those who gave answers of \$10, \$20, \$50 or more per gallon in response to our question about how high the pump price would have to be before they found it unaffordable. Very few low-income consumers gave such high values, while many more did in the high-income tercile. Such responses pulled the average level considered unaffordable significantly upward for high-income consumers, as noted previously.

Figure 7 summarizes the income breakouts for the three different levels of carbon tax we analyzed, \$10, \$40 and \$100 per ton, respectively. It shows the fractions of consumers, grouped into thirds by self-reported household income, who said that they would find gasoline to be unaffordable at those tax levels on top of a base gasoline price of \$2.80 per gallon. Recall that, even without a carbon tax, 4.5% of low-income consumers feel that a gasoline cost of \$2.80 per gallon already affects their travel behavior. That fraction drops sharply as incomes rise, with only 1% of high-income consumers telling us that recent gasoline were high enough to affect their travel choices. A \$10 per ton carbon tax (implying an increase of 9¢ per gallon) would cause little change in the response pattern.

As highlighted previously in Figure 6, a \$40 per ton carbon tax pushes the number of low-income consumers who would feel serious pain at the pump to 14%. That fraction contrasts to the 7% of middle-income consumers and 4% of high-income consumers that the additional 36¢ per gallon would push into the price zone where they say they would change the way they get around.

All of these effects are amplified at a \$100 per ton carbon tax (corresponding to an additional 89¢ per gallon). At that level, 21% of low-income-tercile consumers would find the resulting gasoline price unaffordable. As politically implausible as such a tax (and perhaps even lower tax levels) might seem, actual

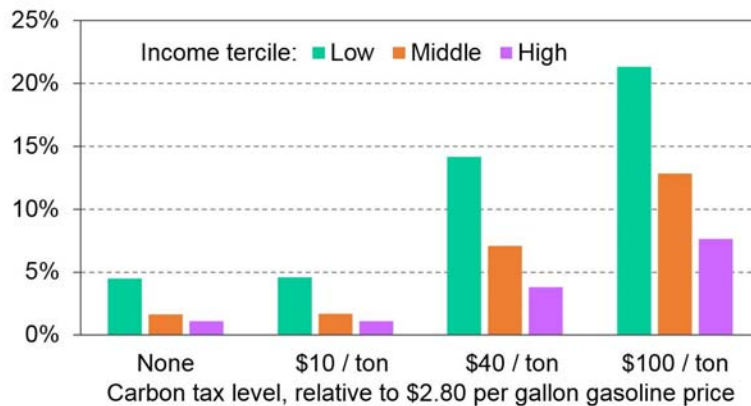


Figure 7. Percentages of consumers who would find gasoline to be unaffordable at given carbon tax levels, breakdown by tercile of household income

gasoline prices were higher than that not so long ago. Consumers certainly were not happy about the situation, but prices driven by market forces as opposed to public policy lack a mechanism for compensating consumers.

Homing in on different segments of the population, as seen in Figures 6 and 7, highlights the perceived vulnerability expressed by low-income consumers. It is well known that a carbon tax would be regressive, i.e., place a relatively greater burden on lower income groups, unless the policy includes provisions for balancing its impact by relieving other taxes or otherwise redistributing the revenues.²³ European studies indicate that the affordability of energy can be improved if a portion of carbon tax revenues were targeted to lower income households.²⁴ Provisions to mitigate the impact of a carbon tax that focus on low-income segments of the population could therefore

help address the concerns of those Americans who most believe that higher motor fuel prices will adversely affect their daily lives.

Nevertheless, even with a \$40 per ton carbon tax, gasoline would remain affordable for the majority of Americans, at least in the sense explored here. Our data suggest that, relative to a \$2.80 base price, such a tax would leave gasoline in a price range considered comfortable by over 90% of U.S. consumers. These estimates provide one quantification of the number of consumers who feel they would be affected adversely based on their personally expressed sensitivity to higher gasoline prices. The results are obtained through a survey that does not influence consumers' responses by framing questions in terms of potentially volatile topics such as taxation, climate action or public policy more generally.

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Suggested citation:

DeCicco, J.M., and A. Truelove. Carbon taxes and the affordability of gasoline. Report from the University of Michigan Energy Survey. Ann Arbor, MI: University of Michigan Energy Institute, September 2017.

The University of Michigan Energy Survey is carried out four times a year as a rider on the University of Michigan Surveys of Consumers. It is conducted through in-depth telephone interviews with a nationally representative sample of 500 U.S. households. For further details and other results, see <http://www.umenergysurvey.com/>.

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