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FACTS AT A GLANCE October 17, 2019

The Pros and Cons of Higher Gas Taxes, and How They Could be Offset for Lower-Income Families

By Phineas Baxandall

Good roads, safe bridges, local and regional bus and train service that is reliable and convenient – these are public investments that connect us to work and family, strengthen our economy, and improve our quality of life. Taxes are the primary way we pay for publicly owned transportation assets and operations, and gas taxes are dedicated to supporting these investments.[1]

Snapshot of findings

- Increasing the gas tax would hit low income households hardest.
- Higher gas taxes will encourage less driving and less fuel consumption.
- Poor households are often less able to adapt to higher prices by reducing their fuel consumption.
- The gas tax is expected to be a declining revenue source due to greater fuel-efficiency and more electric vehicles.
- As gas taxes succeed in reducing fuel consumption, they will undermine overall gas tax revenue.
- There are more progressive and fiscally sustainable ways to increase revenue for transportation.
- A gas tax could be made more progressive by pairing it with low-income tax credits, such as expansions to the Earned Income Tax Credit.

Massachusetts has a history of being a leader in transportation. We built the nation's first bridge, first divided highway, first canal, first subway, and first lighthouse – each of which opened new markets for goods and economic development. Growth was propelled forward by investment in projects such as the Middlesex Canal, rail routes that helped make Massachusetts a hub for New England, and the creation of interstate highways and the Massachusetts Turnpike, which made travel to anywhere in the Commonwealth only a few hours away.

In recent years, transportation has represented more of a problem for the Commonwealth. By one measure, the Boston area suffers the nation's worst traffic congestion.[2] Another ranking of the 50 states ranks Massachusetts 40th for transportation.[3] Along major roads, 475 bridges are structurally deficient.[4] Initiatives to improve our rail networks remain stuck on the drawing board. In some areas served by regional transit authorities, service isn't even available on weekends or evenings.[5] Meanwhile, the average times between subway arrivals have grown significantly for the Massachusetts Bay Transportation Authority (MBTA) while they've shrunk or remained relatively steady in other major transit systems across the country.[6] Shoddy or inadequate transportation systems contribute to other problems, including for health and the environment. Transportation has become Massachusetts' largest and fastest growing source of emissions that cause climate change.[7] Poorly functioning transportation systems contribute to a variety of health problems from asthma, to injuries from collisions, to reduced access to exercise, and healthy foods.

As the Commonwealth seeks the funding to improve our aging transportation system, one proposal policy makers have often considered is raising the gas tax. This paper assesses the gas tax along several well-established criteria for evaluating taxes: efficiency, fairness, and reliability.[8] Based on these criteria, the gas tax receives mixed grades.

On the one hand, by increasing the price of a gallon of fuel, higher gas tax rates prompt some people to drive less, with many benefits for society and the environment. On the other hand, gas taxes tend to hit those with low and moderate incomes the hardest. Policymakers can offset the impact of higher gas taxes on lower-income households with targeted tax policies, although lawmakers must be prepared to accept that doing so will reduce revenues. Additionally, in the long-term, gas taxes as a revenue source are likely to decline because of the growing use of more fuel-efficient and electric vehicles. To the extent that higher gas taxes succeed in reducing driving by vehicles powered by motor fuel, future revenues will diminish.

This paper does not speculate on the impact of how gas tax revenue might be spent or whether the revenue would be spent differently than funds raised through other taxes or fees. Gas tax revenues could be spent in ways that either encourage or discourage more driving. Likewise, other kinds of taxes could be used to raise revenue for additional transportation investment. The paper also does not consider the relative effectiveness of gas taxes compared to other non-tax policies for reducing pollution and traffic congestion.

What is the Gas Tax and How Much Revenue Does It Raise?

The state motor fuels excise, or "gas tax," is 24 cents per gallon, collected by wholesalers, and added into the price at the pump. The Massachusetts Motor Fuels Tax generated $769.1 million in Fiscal Year 2018. Thus, the tax generates about $32 million per penny charged at the pump on each gallon.[9] The state constitution restricts the use of gas taxes to fund highways, mass transit, and associated uses.[10] The tax accounts for roughly 11 percent of total transportation operating and capital revenues raised by the Commonwealth.[11]

The gas tax was last increased by 3 cents in July 2013 and indexed to inflation.[12] The indexing was then overturned by a ballot referendum in 2014, meaning the 24-cent tax loses some of its value each year to inflation. Alongside the gas tax, the Commonwealth adds a 2.54 cent per gallon fee for environmental and replacement costs for underground gasoline storage tanks, effectively bringing the Massachusetts rate to 26.54 cents per gallon.[13]

Back in 1991, the Commonwealth raised both the gas tax rate and transit fares on the MBTA – the last time the state raised both to raise funding for transportation. Adjusting for inflation, the gas rate has since fallen 40 percent, while transit fares have increased some 50 percent to 80 percent.[14]

Massachusetts gas taxes are somewhat below the average of other states. Nationwide, the motor fuel tax paid on the average gallon of gas sold across the U.S. is 24.99 cents and 24.64 cents in the Northeast, both slightly above the Massachusetts 24-cent rate.[15] But other states often apply additional taxes to fuel that either do not exist in Massachusetts or are not applied to motor fuels, such as gross receipts taxes, sales taxes, or local gas taxes. Including all these state and local taxes and fees, the U.S. average tax nationwide is 36.3 cents – almost ten cents above the Massachusetts total rate of 26.54 cents.[16] By this measure, 31 states apply higher total taxes on gas than in Massachusetts.[17]

In addition to the state tax, the federal government levies a separate 18.4-cent gas tax.[18] The federal gas tax has not increased since 1993 when a 4.3 cent increase was enacted along with enhancements to the Earned Income Tax Credit (EITC) and Supplemental Nutrition Assistance Program (SNAP) to offset the

effects on low-income drivers.[19] State and federal combined gas taxes in Massachusetts are 44.94 cents per gallon, including the Underground Storage Tank fee.

Does the Gas Tax Incentivize the Right Things?

Economists often consider motor fuel to be underpriced because its price does not cover the external costs of local pollution, global warming emissions, collisions, traffic congestion, or often even road repair.[20] Higher gas taxes can increase efficiency because raising the price of gasoline at the pump can discourage driving and as a result decrease pollution, traffic congestion, and other driving-related problems.[21]

Higher fuel prices can incentivize these efficiency improvements in several ways. Higher gas prices make it less attractive to purchase a gas guzzler, thus improving the average fuel efficiency of newly purchased cars and encouraging people to replace their gas guzzlers sooner and perhaps to fix rather than scrap their old fuel-efficient vehicle. In households with multiple vehicles, higher priced gas encourages people to switch trips to their more fuel-efficient vehicle. People may also be more likely to consolidate trips together, and to switch to public transit, biking, or walking. Over the long term, higher gas prices also encourage people to live closer to their work, day care, errands, and other regular destinations.

Jet owners typically pay lower taxes

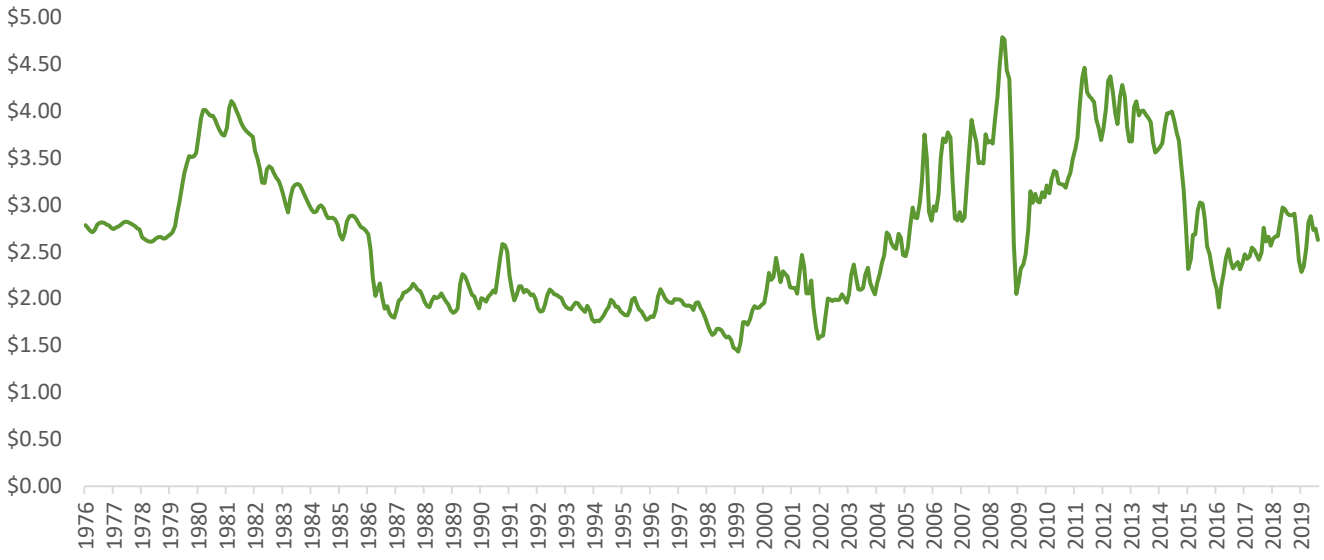
In Massachusetts, jet fuel is taxed differently from gasoline used on highways. There's no state tax on jet fuel, though nine municipalities have chosen to act on a 1985 law creating a local option tax on jet fuel that is presently 10.1 cents per gallon. The revenue generated by the tax goes to the municipalities: Bedford, Boston, Concord, Lexington, Lincoln, Mansfield, Marshfield, Norwood and Worcester.

However, consumers can be less responsive to prices of gasoline than for many other goods because there are often few viable alternatives to car travel.[22] Research has estimated different amounts by which drivers reduce their driving in response to higher gas prices. A 10-cent increase in the Massachusetts gas tax, assuming it was completely passed on to customers in the form of higher prices would represent an almost 4 percent increase over the current $2.59 price of regular gasoline.[23] While conclusions differ, economic studies typically anticipate that a 10 percent price increase would result in a proportionately smaller percent reduction in fuel consumption, at the extremes perhaps as little as 0.4 percent less fuel consumption and as much as a 4 percent reduction in the long-term, depending on other policies.[24]

Drivers may respond less to higher gas taxes if they do not notice the resulting price increase amid other price fluctuations. Small or even medium-sized tax changes may seem like normal price swings caused by global and regional factors such as storms, the business cycle, and geopolitics. As of early October 2019, for instance, a price rise caused by a doubling of the current 24-cent Massachusetts gas tax would still leave the price of regular gas below where it stood a year ago.[25]

Gasoline Prices Vary Considerably Month by Month

Inflation-adjusted average U.S. monthly retail price of regular grade (2019$)



U.S. Energy Information Agency

Is the Gas Tax Fair?

Selective sales taxes such as the taxes levied on gasoline, alcohol, and tobacco raise important equity issues. In general, people with lower incomes tend to spend a greater share of their income on these products, even when consuming the same amount or less than a high-income person. For example, if a low- and a high-income person each purchase 12 gallons of gasoline, the taxes on this purchase will consume a larger portion of the low-income person's earnings than that of the high-income person. Taxes on these items therefore are "regressive" in their effect.[26]

Data from the Institute on Taxation and Economic Policy (ITEP) show how the current system of state and local taxes in Massachusetts is regressive. The lack of graduated brackets for the state income tax and a significant reliance on the sales tax are major reasons the Commonwealth's tax system is "upside down." The lowest-income 20 percent of households pay 10 percent of their income, on average in state and local taxes. Households in the middle pay around 9 percent; and the top 1 percent contribute less than 7 percent of their income on average to state and local taxes.

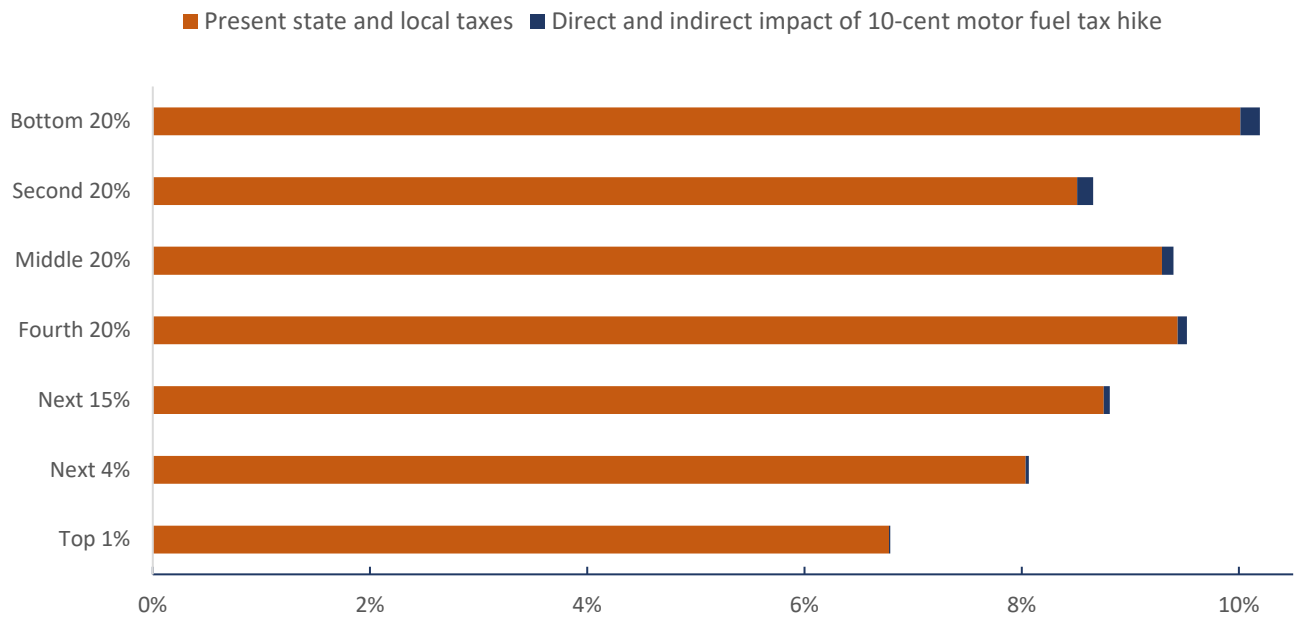
Regressive and progressive taxes

A tax is ***progressive*** if the share of income people pay for that tax tends to increase as their income rises. Progressive taxes shift taxes away from those with the least ability to pay, and onto people with more income. The federal income tax and many state income taxes are progressive: the higher someone's income, the higher effective tax rate they pay.

A tax is ***regressive*** if the share of income paid for that tax tends to increase as income decreases. Regressive taxes ask those with the least to contribute the most as a share of income. State taxes on consumption, such as the sales, gas, and cigarette taxes, are all regressive. Other user fees such as tolls, transit fares, and drivers' license fees are also regressive forms of revenue collection.

Higher Gas Taxes Would Increase the Gap in the Share of Income Low and Middle Pay Compared to Highest Incomes

Percent of state and local taxes paid by Massachusetts income group



An increase in the gas tax would make Massachusetts taxes more regressive. Consider how a 10-cent increase to the state gas tax would impact households with different incomes. If such an increase was in place in 2019, it would raise approximately $328 million in additional revenue. Those in households with middle and low incomes, however, would pay significantly larger shares of their income toward this increase than would the highest-income households. The additional tax would represent almost 0.20 percent of income for the lowest-income fifth of households; about 0.15 percent of income for the next lowest-income fifth; about 0.10 percent of income for the next two-fifths of the income spectrum; and about 0.05 percent for the next highest 15 percent of income earners.

Meanwhile, the highest-income 1 percent of households would contribute less than 0.01 percent (a hundredth of one percent) of their income toward this gas tax increase – despite purchasing on average the most gas. They would need to consume almost 50 times more gas than the middle 20 percent of households and nearly 200 times more gas than households in the bottom 20 percent of incomes in order to pay a similar share of their income toward the gas tax increase.

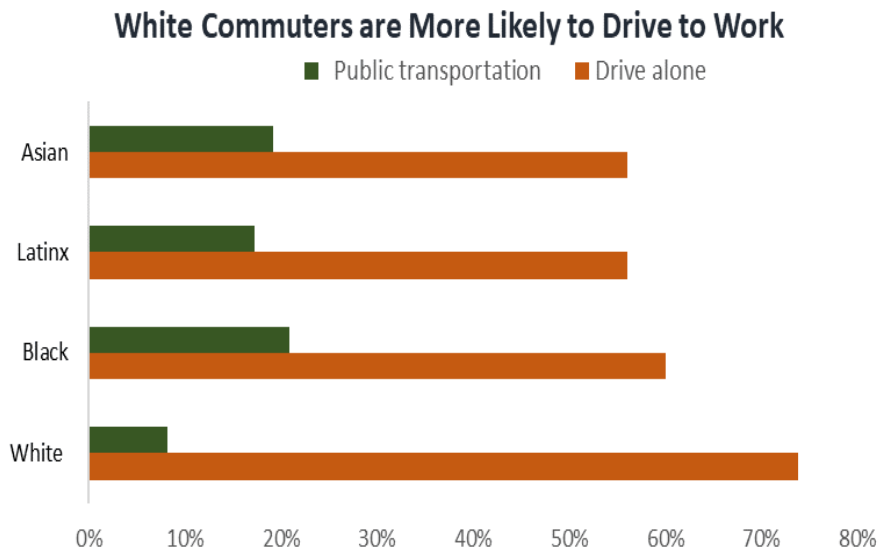
The Departments of Revenue in Minnesota and Texas, have studied the incidence of their gas taxes in their states and similarly find gas taxes hit those with lower incomes the hardest.[27] In both states, without exception, the studies found that each successively higher income group pays a smaller portion of their income in gas taxes.

Other studies have explored how high-income households tend to drive somewhat more miles, but not nearly in proportion to their much higher incomes. One recent academic study finds not only that "the poor pay a higher percentage of income to gasoline taxes than do the rich," but also that poor households are often less able to adapt to higher prices by reducing their fuel consumption (even

though they have a greater incentive to do so).[28] The study suggests that higher-income households may tend to have an easier time reducing their fuel consumption because they are more likely to own multiple vehicles and can more readily consolidate trips with one vehicle or shift trips to their more fuel-efficient vehicle. Some studies show that, on average, higher-income households reduce their driving *miles* less in response to higher prices.[29] Low-income households are less likely than high-income households to drive electric vehicles that don't consume gas. A study using 2017 National Household Travel Survey data, found that, "electric vehicles are disproportionately driven by high-income households, with more than two-thirds of all foregone gasoline tax revenue coming from households with $100,000+ in annual income."[30]

In general, higher gas taxes have a greater impact on rural households. People living in rural areas tend to have few other travel options besides automobiles and they typically drive more.[31] Rural households tend to reduce their driving miles more in response to higher gas taxes, but nonetheless bear a disproportionately greater financial burden.[32] Evidence suggests that rural households with one vehicle reduce their gas consumption the least in response to the price of gasoline,[33] presumably because there are few options to do so.

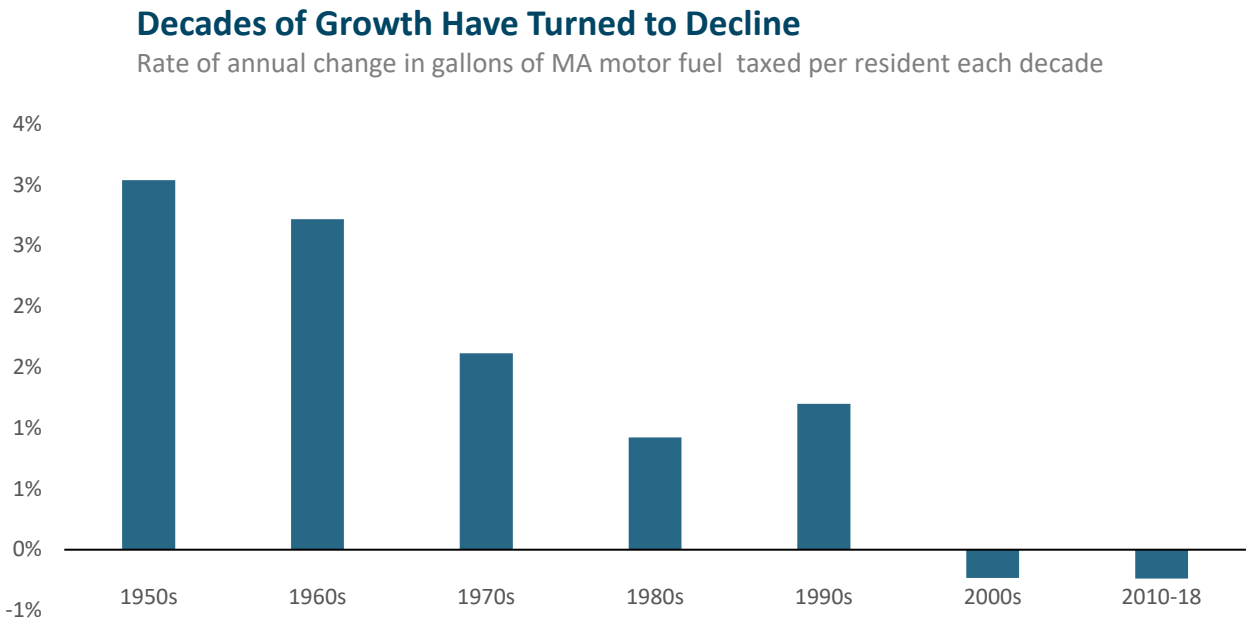
The impact of higher gas taxes is more complex when viewed by race. Historic and modern day systemic barriers to opportunity have prevented Black and Latinx people in Massachusetts from equitable access to high-paying jobs, education, and other avenues leading to higher household income.[34] As a result, Black and Latinx workers are over-represented among low-income households and underrepresented among higher-income households. Certain groups in the Asian and Pacific Islander community have faced similar barriers. Black, Latinx and some Asian households are therefore likely to shoulder disproportionate responsibility for paying higher gas taxes– both as drivers who directly pay the tax and as consumers who pay slightly higher prices on goods as a result of businesses and truckers paying the tax.[35] On the other hand, this racially disproportionate impact is muted somewhat because Blacks, Latinx, and Asian commuters are less likely to drive to work than whites.[36]



There are different ways the Commonwealth could generate additional funding for transportation that would make the tax system more progressive. One way is to rely more on progressive taxes (such as personal income taxes, corporate taxes, and estate taxes) or introduce new progressive sources of revenue.[37] A second solution could be to couple a gas tax increase with tax credits that would offset the financial impact of higher gas taxes for many low- and moderate-income families. The last section of this paper illustrates how a gas tax could be paired with an increase to the Earned Income Tax Credit to offset the overall impact of the tax changes for the lower 40 percent of households in the Commonwealth.

Gas Taxes Are a Declining Revenue Source

Providing a strong transportation network to support a growing economy requires revenues that keep pace with these growing needs. For most of the 20th Century, the number of gallons of motor fuel subject to tax grew steadily in Massachusetts.[38] In the last 14 years, however, the number of gallons taxed has declined, despite continuing growth of the population and the longest uninterrupted economic expansion in history. After decades of steady growth, the tax base no longer keeps up with the population.



Advancing technology has made it possible for vehicles to drive the same distance with less fuel. New vehicles already travel about 30 percent further on a gallon of gas, on average, than they did in 2004.[39] Existing technology makes far more fuel-efficient vehicles possible for the future, a fact that enabled the Obama Administration to require automakers to achieve the equivalent of an average of 54.5 miles per gallon for new vehicles by 2025.[40] While the Trump administration overturned this rule, it nonetheless demonstrates how gasoline may be an unstable base for long-term transportation revenue.

Increasingly, vehicles in Massachusetts may not be subject to the gas tax at all because a growing number of cars and trucks are likely to run on electricity or other power sources. Sales of electric vehicles in the state nearly doubled in 2018 over 2017, but still represented only about 2.5 percent of all new sales.[41] Massachusetts is committed by law to follow California standards for increasing the use of zero-emission vehicles (which don't burn fuel). That commits the state to having 300,000 registered zero-emission vehicles by 2025.[42] Moreover, the Commonwealth has entered into a regional process with a dozen other states and the District of Columbia to cap transportation emissions starting as early as 2022 and ratchet that cap down each year as part of the Transportation Climate Initiative (TCI).[43]

Navigating the Tension Between Revenues, Incentives, and Fairness

Increasing gas tax rates would encourage people to drive and pollute less, but it would worsen tax fairness, making our upside-down tax system even more lopsided. Moreover, insofar as a higher gas

tax succeeds in reducing fuel consumption, it will be levied on a shrinking tax base. Sustaining revenues will require continual increases to the gas tax rate, which would fall most heavily on those with middle and low incomes. There are more fiscally sustainable and progressive ways to generate revenue for transportation, such as through targeted changes to corporate or personal income taxes.

If policy makers decide to increase the gas tax, the disproportionate impact on low- and moderate-income households should be offset by coupling the increase with complementary policies to cushion the impact on these households, such as an expansion of the state's Earned Income Tax Credit (EITC).

The EITC is one of the broadest and most effective anti-poverty programs in the Commonwealth. It supports families in every municipality,[44] and provides well-documented additional benefits to health, increases educational attainment, and boosts future earnings of children from recipient families.[45] About 90 percent of all EITC recipients come from households in the bottom 40 percent of household incomes. The income cap for receiving the EITC depends on family size. For large families, income eligibility is capped at $55,952 in 2019.[46]

What would it take for the EITC to offset the gas tax?

In order to fully offset the average cost of a gas tax increase for the lowest income 40-percent of households as a group, each one cent of gas tax increase could be coupled with a 0.8 percentage point increase to the state Earned Income Tax Credit match. For example:

- A 10-cent gas tax increase would require an 8-percentage point increase to the state EITC match, reducing the $328.3 million revenue gain by $75 million.
- A 15-cent gas tax increase would require a 12-percentage point increase to the state EITC match, reducing the $492.5 million revenue gain by $113 million.
- A 20-cent gas tax increase would require a 16-percentage point increase to the state EITC match, reducing the $656.6 million revenue gain by $150 million.
- A 25-cent gas tax increase would require a 20-percentage point increase to the state EITC, reducing the $820.8 million revenue gain by $188 million.

You can read an explanation of the Massachusetts EITC (HERE).

There are several benefits to using the EITC to offset a gas tax. First, the costs and benefits of such a combined package of changes would both be delivered through the tax system. Moreover, people with greater needs, because of larger family size, will tend to receive larger EITC benefits. Since the EITC benefit is linked to employment income, low-income commuters who drive to work would see both an increase to their gas costs and a boost to their after-tax earnings. The EITC benefit does not diminish the gas tax incentive for households to find ways to reach work without driving, such as through carpooling, taking transit, or walking.

The costs and benefits of a combined increase to the EITC with a gas tax would vary significantly among households in the lower-income 40 percent. Those who drive less would generally pay less-than-average gas tax costs. Households receive more or less than average EITC benefits depending on their employment income and the number of eligible children. Tax filers are ineligible for EITC if they are outside of the 25-64 year age range, or if they do not have a social security number. Households are also ineligible if they do not earn an income, even if they are disabled or stay at home to care for dependents. Households without custodial children can receive only extremely low benefits.[47]

The Commonwealth could choose to broaden EITC benefits to more low and moderate-income families. Eligibility could be fully extended to younger and older workers, as well as workers who lack a social security number but have a valid taxpayer identification number. New York and Washington,

DC extend their EITC to noncustodial parents as a way to broaden the benefits. Similarly, Maryland, Maine, Minnesota, and California, have expanded age eligibility beyond the federally defined range. Credits could also be extended for those caring for dependents at home and for low-income adults attending college.

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[1] Revenue from the "Motor Fuels Tax" is mostly from the gas tax, but also includes aviation and other specialty propulsion fuels.
[2] INRIX, "2018 Global Traffic Scorecard" at http://inrix.com/scorecard
[3] U.S. News and World Report, "Best States 2019" (Sept. 2019) see "Transportation" at https://www.usnews.com/news/best-states/rankings/infrastructure/transportation
[4] This 2018 measure was four more bridges than in 2017. See Massachusetts Department of Transportation, "Performance Tracker" https://massdottracker.com/highway
[5] Report of the Task Force on Regional Transit Authority Performance and Funding, (April 2019). "The extent of service offered varies widely; some RTAs provide night and weekend services, but others do not." (p.7) at https://d3n8a8pro7vhmx.cloudfront.net/t4ma/pages/37/attachments/original/1559150616/dot-rta_task_force_report_040519.pdf?1559150616 .
[6] Boston Indicators "The MBTA versus Other Legacy Transit Systems," analysis of National Transit Database comparing year 2000 to 2015 (Figure 4) at https://www.bostonindicators.org/article-pages/2018/february/the-mbta-versus-other-legacy-transit-systems
[7] Commonwealth of Massachusetts, Commission on the Future of Transportation (2019), Volume 1, page 24 https://www.mass.gov/files/documents/2019/01/10/FOTCVolume1.pdf
[8] Simplicity, transparency, and ease of compliance and administration are additional considerations for evaluating a tax. The gas tax does well on these considerations because it is easily administered at the wholesale level.
[9] Almost all motor fuel used on public roads is taxed and the vast majority of it is gasoline. Roughly 0.6 percent of motor fuel is not assessed for taxation because it is driven by federal or other government vehicles, subject to allowances for nonhighway use, or is an allowance for evaporation or other loss. By volume, roughly 13 percent of fuel subject to the tax is diesel, liquefied gases or other special fuels. According to the Department of Revenue, "Special fuels are all fuels, except gasoline, used to propel motor vehicles on or over the highway. Special fuels include diesel and all liquefied gases (propane, CNG, LNG, etc.)." Moreover, "the tax rate on diesel is fixed at $.24 per gallon, while the tax rate on liquefied gases is set each quarter, recently fluctuating between $.16 and $.24 per gasoline gallon equivalent." At "DOR Motor Fuel Excise," viewable at https://www.mass.gov/info-details/dor-motor-fuel-excise.
[10] Article *LXXVIII* of the Massachusetts Constitution states, "No revenue from fees, duties, excises or license taxes relating to registration, operation or use of a vehicle on public highways, or to fuels used for propelling such vehicles, shall be expended for other than cost of administration of laws providing for such revenue, making of refunds and adjustments in relation thereto, payment of highway obligations, or cost of construction, reconstruction, maintenance and repair of public highways and bridges, and mass transportation lines and of the enforcement of state traffic laws, and for other mass transportation purposes; and such revenue shall be expended

by the commonwealth or its counties, cities and towns for said highway and mass transportation purposes only and in such manner as the general court may direct; provided, that this amendment shall not apply to revenue from any excise tax imposed in lieu of local property taxes for the privilege of registering such vehicles." See https://malegislature.gov/Laws/Constitution#amendmentArticleLXXVIII

[11] Based on anticipated FY 2020 motor fuels revenue, as listed in the final FY 2020 conference budget. There is no official tally of total state transportation spending. This estimate is based on FY 2020 capital spending for MassDOT and the MBTA (in the state's Capital Investment Plan), plus a FY 2015 estimate of operating revenues compiled by MassBudget. See FY 2020-2024 Capital Investment Plan, and MassBudget, "What Does Massachusetts Transportation Funding Support" (2017) at http://www.massbudget.org/report_window.php?loc=What-Does-MA-Transportation-Funding-Support.html http://massdot.maps.arcgis.com/apps/MapJournal/index.html?appid=33a118c32b3f47b3b90a769498aa68bd#

[12] Mass. Gen. Laws ch. 64A, § 1, viewable at https://malegislature.gov/Laws/GeneralLaws/PartI/TitleIX/Chapter64A/Section1/

[13] The fee is used to reimburse the costs of remediating environmental damage and providing partial reimbursement to municipalities replacing underground fuel tanks. This fee is adjusted annually for inflation.

[14] Subway fares increased 48 percent based on the current $2.40 rate with a Charlie Card and 79 percent with the current $2.90 price for a ticket. Bus fare increased 49 percent with a Charlie Card and 75 percent with a ticket or cash. The inflation-adjusted amounts compare price indexes for January 1991 and August 2019, the most recent data at the time of writing. Gas taxes were increased to 21 cents in January 1991. For a list of fare increases between 1989 to 2016, see https://commonwealthmagazine.org/uncategorized/pulling-the-data-together/ and linked spreadsheet.

[15] State and regional averages are volume weighted and based on rates as of October 1, 2019, according to American Petroleum Institute, "State Motor Fuel Taxes" at https://www.api.org/~/media/Files/Statistics/State-Motor-Fuel-Taxes-Report-October-19.pdf

[16] American Petroleum Institute, "State Motor Fuel Taxes" at https://www.api.org/~/media/Files/Statistics/State-Motor-Fuel-Taxes-Report-October-19.pdf

[17] American Petroleum Institute, "State Motor Fuel Taxes" at https://www.api.org/~/media/Files/Statistics/State-Motor-Fuel-Taxes-Report-October-19.pdf

[18] The federal tax on diesel fuel is 24.4 cents per gallon.

[19] Congressional Research Service paper (page 3) notes, "the credit was intended to partly offset a gasoline tax increase" https://fas.org/sgp/crs/misc/R44057.pdf . If the federal gas tax had been indexed to inflation in 1993, today it would be over 32 cents a gallon.

[20] See for instance, David Coady, Ian WH Parry, and Baoping Shang, "Energy Price Reform: Lessons for Policymakers," *Review of Environmental Economics and Policy*, 2018, 12 (2), 197-219.

[21] For a Massachusetts analysis of how reduced driving miles could correspond to these specific benefits, see Phineas Baxandall and John Olivieri, "What's at Stake: How Decreasing Driving Miles in Massachusetts Will Save Lives, Money, Injuries, and the Environment" (Transportation for Massachusetts, 2015) at https://www.t4ma.org/whatsatstake

[22] Eliana Eitches and Vera Crain, "Using gasoline data to explain inelasticity ," Beyond the Numbers: Prices & Spending, vol. 5, no. 5 (U.S. Bureau of Labor Statistics, March 2016) at https://www.bls.gov/opub/btn/volume-5/using-gasoline-data-to-explain-inelasticity.htm

[23] Massachusetts Energy Planning and Analysis Division, "Massachusetts Retail Gasoline and Diesel Fuel Prices" viewed October 9, 2019 at https://www.mass.gov/service-details/massachusetts-retail-gasoline-diesel-fuel-prices

[24] Economists measure price responsiveness by a metric called price "elasticity." An elasticity higher than 1 means the quantity purchased would change by a larger percentage than the price. Gasoline price elasticity estimates are typically smaller. A 0.5 elasticity means that a 10 percent increase in the price results in a half as large reduction in quantity consumed: 5 percent. Examples of different economic estimates of gasoline price elasticity:

- Kenneth Gillingham, Alan Jenn, and Inex M.L. Azevedo (2015) estimate 0.1 in "Heterogeneity in the response to gasoline prices: evidence from Pennsylvania and implications for the rebound effect," *Energy Economics* (December 2015) at https://www.sciencedirect.com/science/article/pii/S0140988315002340?via%3Dihub

- Tomas Havrenek and Ondrej Kokes, estimate 0.1 in the short run and 0.23 in the long run. See "Income elasticity of gasoline demand: A meta-analysis," *Energy Economics* (2015) at https://doi.org/10.1016/j.eneco.2014.11.004].
- Roger von Haefen, Antonio Bento, Lawrence Goulder, and Mark Jacobsen (2009) estimate that each 1 percent increase in the price of gasoline results in a 0.2 percent reduction in gasoline consumption, mainly from a reduction in driving miles. See "Distributional and Efficiency Impacts of Increased U.S. Gasoline Taxes," *American Economic Review* (May 2009), also available at https://ecommons.cornell.edu/bitstream/handle/1813/58106/Cornell_Dyson_wp0719.pdf?sequence=1
- Zia Wadud, Daniel Graham, and Robert Noland find an average elasticity of 0.34, and large differences between different types of households. See "Gasoline Demand with Heterogeneity in Household Responses," *The Energy Journal* (December 2009), p. 22 at https://www.researchgate.net/publication/260602923_Gasoline_Demand_with_Heterogeneity_in_Household_Responses .
- A Congressional Budget Office study in 2008, concluded that a 10 percent price increase would decrease fuel consumption only 0.6 percent in the short term, but over a 15-year period when vehicles were replaced by other models, it would lead to a 4 percent decrease, an elasticity of 0.4. https://www.cbo.gov/sites/default/files/110th-congress-2007-2008/reports/01-14-gasolineprices.pdf (page xi).
- A literature review, published in 2004 by Phil Goodwin, Joyce Dargay, and Mark Hanly, "Elasticities of Road Traffic and Fuel Consumption with Respect to Price and Income: A Review" *Transport Reviews* (May 2004) concludes that an inflation-adjusted 10 percent decline in fuel prices will result in a reduction in the volume of fuel consumed of about 2.5 percent, building up to 6 percent in five years or so (p. 278). See https://www.researchgate.net/publication/32885803_Elasticities_of_Road_Traffic_and_Fuel_Consumption_with_Respect_to_Price_and_Income_A_Review.
- Elisheba Spiller, Heather M. Stephens, and Yong Chen (2017) find a price elasticity of 0.74. See "Understanding the heterogeneous effects of gasoline taxes across income and location," *Resource and Energy Economics* (2017) at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2113594 .
- Michael Gelman, Yuriy Gorodnichenko, Shachar Kariv, et. al.(2017), use a dataset of personal financial data to estimate elasticity at about 1 in *National Bureau of Economic Research Working Papers*, "The Response of Consumer Spending to Changes in Gasoline Prices," available at https://www.nber.org/papers/w22969 or revised at http://www-personal.umich.edu/~shapiro/papers/gasprices.pdf

[25] Commonwealth of Massachusetts, "Massachusetts Retail Gasoline & Diesel Fuel Prices" at https://www.mass.gov/service-details/massachusetts-retail-gasoline-diesel-fuel-prices

[26] Data suggest that higher-income households may consume more gasoline than lower-income households, but not in proportion to their much higher income. See for example, Consumer Expenditure Survey data presented in slides four and five, from Resources for the Future, "Cap and Invest: Understanding the Impact on Households," (April 2019) at www.transportationandclimate.org/sites/default/files/2_Keyes_20190430.pdf#page=5 Independently, using a statewide travel survey in California in 2010-2011, The Mineta Transportation Institute found that, "The lowest income quintile group burns approximately 1 gallon of fuel and drives approximately 21 miles per day, while the highest income group burns almost twice as much fuel (1.9 gallons) and travels more than twice as far (47.2 miles) in a typical day." (They find higher-income people drive somewhat more fuel-efficient vehicles). https://transweb.sjsu.edu/sites/default/files/1426-household-income-and-vehicle-fuel-economy-in-california.pdf

[27] In Minnesota, household outlays for motor fuel taxes among the highest-income 1 percent represent only 0.06 percent of household income, while these same taxes represent 1.66 percent of income for the lowest-income 10 percent of households. Minnesota Department of Revenue, Tax Research Division, "2019 Minnesota Tax Incidence Study: An Analysis of Minnesota's household and business taxes," (March 1, 2019), p.123, available at https://www.revenue.state.mn.us/sites/default/files/2019-03/%2B2019_tax_incidence_study_Nolinks_0.pdf . The Texas Comptroller's 2018 tax study divides the population into five income groups, and finds that the lowest income group, with incomes less than $37,630, spends 0.7 percent of their income in gas taxes. Meanwhile the

highest-income group, with incomes over $149,453 spends only 0.1 percent of their incomes on gas taxes. See Texas Comptroller of Public Accounts, "Tax Exemptions & Tax Incidence" (Nov. 2018), p. 65 at https://comptroller.texas.gov/transparency/reports/tax-exemptions-and-incidence/2018/96-463.pdf

[28] Elisheba Spiller, Heather M. Stephens, and Yong Chen, "Understanding the heterogeneous effects of gasoline taxes across income and location," *Resource and Energy Economics* (2017), p. 25, at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2113594

[29] On the interaction with multiple-vehicle ownership and urban living, see "Gasoline Demand with Heterogeneity in Household Responses" available from: https://www.researchgate.net/publication/260602923_Gasoline_Demand_with_Heterogeneity_in_Household_Responses. On decreasing elasticity among higher-income households, see Chen Haotian, Russell Smyth, and Xibin Zhang, "A Bayesian sampling approach to measuring the price responsiveness of gasoline demand using a constrained partially linear model," pp. 19-21, available at https://www.researchgate.net/publication/319406390_A_Bayesian_sampling_approach_to_measuring_the_price_responsiveness_of_gasoline_demand_using_a_constrained_partially_linear_model. They note that their "results are consistent with the general consensus that consumers are less sensitive to gasoline price rises as their income increases" (p.17).

[30] Lucas W. Davis and James M. Sallee, "Should Electric Vehicle Drivers Pay a Mileage Fee?" National Bureau of Economic Research Working Paper, No. 26072 (July 2019), p. 2 at https://www.nber.org/papers/w26072.pdf. The authors find that nationally, "Electric vehicles as a percentage of all vehicles increases from close to zero percent for annual incomes below $25,000, to 1 percent for annual incomes $75,000-$125,000, to 4 percent for annual incomes above $200,000" (page 27). These patterns may have shifted some since 2017.

[31] National Household Travel Survey 2017. The survey reports that people in urban areas averaged 23.0 vehicle miles daily, as opposed to people in non-urban areas that traveled 33.5 miles daily (p.97). The percent of people over 16 who are not drivers is almost twice as high in urban areas than non-urban areas; and the percent with no vehicle available to the household is more than three times as high (p.99).

[32] Elisheba Spiller, Heather M. Stephens, and Yong Chen, "Understanding the heterogeneous effects of gasoline taxes across income and location," *Resource and Energy Economics* (2017), p. 30, at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2113594

[33] "Gasoline Demand with Heterogeneity in Household Responses," page 19, available from: https://www.researchgate.net/publication/260602923_Gasoline_Demand_with_Heterogeneity_in_Household_Responses.

[34] See MassBudget, "Obstacles on the Road to Opportunity: Finding a Way Forward," (October 2018).

[35] Differences exist between ethnic subgroups within each racial group. This is clear by examining whether workers of a particular ethnic subcategory are more or less likely to be low-income car commuters than are workers in Massachusetts as a whole. Among Asians, for instance, the percent of low-income Japanese drivers among all Japanese workers is below average. The same is true of Indian car commuters. By contrast, the percent of low-income Pakistani and Cambodian drivers among all Pakistani and Cambodian workers (respectively) is above average. Likewise, among Latinx, the percent of low-income Argentinian drivers among all Argentinian workers is below average. Meanwhile, the percent of low-income Dominican or Puerto Rican drivers among all Dominican or Puerto Rican workers is above average. These findings are based on U.S. Census, ACS 2013-2017 microdata. Low income is defined as less than 200 percent of the federal poverty level. Car commuters excludes carpoolers.

[36] Displacement from densely settled walkable cities as a result of rising housing costs could reduce or even reverse these differences in commuting patterns over time. The data do not include travel for purposes other than travel to work. Data presented here also do not include carpooling, or other modes of travel, or other races. Whites are non-Hispanic or non-Latino only. Note that whites are somewhat underrepresented in the small number of commuters who carpool to work. See U.S. Census, Means of Transportation to Work by Selected Characteristics, 2013-2017, American Community Survey 5-Year Estimates.

[37] See MassBudget, "14 Options for Raising Progressive Revenue" (January 2019) at http://massbudget.org/report_window.php?loc=14-Options-for-Raising-Progressive-Revenue.html

[38] Whereas in 1950 there were 200 gallons sold for each resident in the state, by 2004 this number had reached over 500 gallons. The volume of taxed fuel listed here subtracts gasoline and special fuels that were subsequently

refunded or fuel that was tax exempt have been subtracted. Federal Highway Administration, Highway Statistics 2017, chart MF-202 at https://www.fhwa.dot.gov/policyinformation/statistics/2017/mf202.cfm . Population data is U.S. Census estimates.

[39] U.S. Environmental Protection Agency, "20018 Automotive Trends Report," (2019). See page 6 comparing model years 2017 and 2004, with a 29 percent increase in fuel efficiency, at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100W5C2.PDF?Dockey=P100W5C2.PDF

[40] *Washington Post*, "Autos must average 54.5 mpg by 2025, new EPA standards say," Aug. 28, 2012 at https://www.washingtonpost.com/national/health-science/autos-must-average-545-mpg-by-2025-new-epa-standards-are-expected-to-say/2012/08/28/2c47924a-f117-11e1-892d-bc92fee603a7_story.html

[41] Includes sales of electric vehicles (PHEV and BEV) and the EV market share as a percent of total light vehicles sold. See https://evadoption.com/ev-market-share/ev-market-share-state/. If policy at the federal, state, or local level began treating climate change as an urgent crisis, then gasoline consumptions could be reduced much more quickly. The city of Vancouver recently set the goal that in 11 years (2030), two-thirds of all trips would be walking, biking, or public transit as opposed to private vehicles. Of the remaining vehicle miles, the city is committing that at least half will be zero-emission vehicles (which don't consume gasoline). See City of Vancouver, "Climate Emergency Response" administrative plan (April 16, 2019) at https://council.vancouver.ca/20190424/documents/cfsc1.pdf

[42] "Zero-Emission Vehicle (ZEV) Commission" at Commonwealth of Massachusetts https://www.mass.gov/service-details/zero-emission-vehicle-zev-commission

[43] Commonwealth of Massachusetts, "Transportation and Climate Initiative (TCI)" at https://www.mass.gov/service-details/transportation-and-climate-initiative-tci

[44] "State Earned Income Tax Credit by City and Town in Massachusetts" at Kids Count Data Center https://datacenter.kidscount.org/data/tables/8526-state-earned-income-tax-credit-eitc-claims-by-city-and-town-county-subdivision?loc=23&loct=11 - detailed/11/3324-3674/false/573/any/19076

[45] "A Credit to Health: The Health Effects of the Earned Income Tax Credit," Massachusetts Budget & Policy Center (May 2018), available at http://massbudget.org/report_window.php?loc=A-Credit-to-Health.html

[46] IRS, "2019 EITC Income Tax Limits, Maximum Credit Amounts and Tax Law Updates" at https://www.irs.gov/credits-deductions/individuals/earned-income-tax-credit/eitc-income-limits-maximum-credit-amounts-next-year

[47] A limitation of the EITC is that because it is received only at the end of the year, the benefits are not available for short-term cash flow problems to pay rent, utilities, or other outlays that can't be postponed until then.