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THE CENTER FOR STATE POLICY ANALYSIS

ASSESSING THE IMPACT OF TCI

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Cars and trucks are a major source of greenhouse gases and other pollutants detrimental to public health. To minimize these baleful emissions, Massachusetts is working with other Northeast states on a collective approach known as the Transportation Climate Initiative, or TCI.

Under TCI, participating states would place a limit on total carbon emissions from motor vehicles. Then they would set up an auction, where fuel suppliers bid for the right to sell gasoline and diesel with a certain amount of carbon.

This auction process has two main benefits. By putting a price on carbon emissions, the auctions would encourage fuel efficiency and reduce pollution. At the same time, the money raised would be used by states to fund green investments, climate justice, and other TCI priorities.

Determining the precise, real-world impact of TCI is complicated, both because the exact terms of the program are still being negotiated and because much depends on the future path of global oil prices and overall economic growth.

To do justice to this uncertainty, we model a variety of different assumptions and present a range of scenarios showing how TCI

could affect overall emissions, state revenues, public health, and gasoline prices.

We find that:

- Without TCI, emissions from motor fuels are likely to fall between 2022 and 2032. Our central estimates suggest a decline of 14.2 percent (in our moderate-economic-growth scenario) or 17.5 percent (in our low-economic-growth scenario).

- TCI aims to generate additional reductions on top of this baseline, producing overall declines of 20, 22, or 25 percent, with the exact target as yet undecided.

- These additional, TCI-generated emissions reductions could bring significant benefits, including in the realm of public health. **Preliminary estimates from a multi-university group** suggest that TCI could eliminate several hundred cases of childhood asthma each year in Massachusetts.

- TCI's auctions would generate substantial revenue for participating states. While each state would ultimately make its own spending decisions, this revenue is intended to support green initiatives and environmental justice, with states recently proposing to devote at least 35 percent to **underserved and overburdened communities**. In our moderate-growth scenario, a 22 percent emissions target would generate $775 million for Massachusetts in 2022; in the low-growth scenario, it would raise $406 million.

- TCI would almost certainly result in higher gas prices, and the size of the increase would depend on the stringency of the emissions target. In our moderate-growth scenario, a 22 percent reduction in emissions would generate a 24-cent-per-gallon increase in gas prices in 2022; in our low-growth scenario, gas prices would rise 13 cents per gallon.

- TCI also includes a price ceiling, which would prevent auction prices and gas prices from rising beyond established limits. Many of our estimates — including the central estimates noted here — may be above the price ceiling. In that case, real-world prices would not rise as much as we predict; instead, the emissions cap would be loosened, allowing higher emissions as a way to check prices.

- Not all regions of Massachusetts would be similarly affected by TCI. More diverse urban areas currently have the worst pollution, and therefore stand to gain the most from reduced tailpipe emissions. Meanwhile, communities in Central and Western Massachusetts spend the highest share of their income on gasoline, making them more vulnerable to price increases.

What follows is a fuller elucidation of these points, including background information on TCI, a detailed account of our findings, and a look at the potential risks, expansions, and alternatives.

HOW TCI WORKS

Cars, trucks, and other transportation vehicles generate more carbon emissions across the Northeast than any other single source — more than power plants, buildings, or factories. In fact, over 40 percent of all regional carbon pollution **comes from transportation**.

TCI offers a collaborative approach to this regional problem, bringing together **a dozen states and Washington, D.C.**, in an effort to reduce transportation emissions **and also** "improve public health, create new economic opportunities, and provide enhanced mobility options for all communities."[1]

At the heart of TCI is a "cap-and-trade" system that proponents have rebranded "cap-and-invest." It's a well-tested approach to carbon reduction that has **proved effective around the world** as well as here in the Northeast, where the Regional Greenhouse Gas Initiative (RGGI) has used a cap-and-trade approach to curb power plant emissions.

Here's how TCI's proposed cap-and-trade system would work:

1. Participating jurisdictions decide — as a group — how many metric tons of emissions to allow from the transportation sector.

2. They set up an auction, where companies that supply transportation fuels (gasoline and on-road diesel) bid for carbon allowances — or the right to sell fuels with a certain number of metric tons of carbon dioxide. As an example, if the total cap were 200 million metric tons, a supplier might bid for enough allowances to sell fuel with 20 million metric tons of CO_2.

3. With fuel suppliers competing for a limited number of allowances, the auction effectively establishes a market price, which will depend on the size of the emissions cap and expected demand for gasoline and diesel.

4. The money collected through this auction goes to the states — likely in proportion to their fuel usage. It is meant to support the stated goals of the TCI program, which include helping communities adversely affected by climate change and funding programs that reduce emissions.

5. After the auction, fuel suppliers can continue trading these emissions rights, selling unused allowances to competitors who need more.

6. Each year, the emissions cap declines at a predetermined rate to ensure continued reductions.

TCI INVESTMENTS

Selling carbon allowances via auction will generate significant revenue for the states, amounting to billions of dollars each year across the region and hundreds of millions in Massachusetts.

The TCI program doesn't dictate exactly how such revenues will be spent; those decisions would fall to state legislators and governors. But possibilities include support for transit, electric vehicles, climate resilience, and air-quality improvements. The right mix of investments could amplify the program's impact, producing greater emissions reductions with smaller gas price increases.

To achieve more equitable outcomes, a recent TCI proposal asks states to commit at least 35 percent of their revenue to **underserved and overburdened communities**, with input from state-level advisory bodies and regular reporting on results.

The absence of concrete spending information makes it hard to measure the precise effects of TCI investments. As a proxy, we look at a similar program in California that regularly reports on the efficacy of its investments. Using their latest data, we establish a range of plausible impacts where TCI investments reduce the demand for motor fuels up to 2 percent per year.

GAS PRICES

While fuel suppliers would initially pay for the right to sell carbon-emitting fuels, they would likely pass those costs along to consumers in the form of higher gasoline and diesel prices.

This isn't always the case in economics. In other situations, businesses forced to pay a price for carbon might try to spare their customers by squeezing suppliers. But fuel providers **generally lack this option**, as they purchase their fuel in a global market that gives them little negotiating power over refineries or the spot price of oil.[2]

And far from being an unfortunate side-effect, this pass-through to consumers is part of why TCI is expected to reduce emissions.

In the short term, higher gasoline prices will encourage people to seek ride-sharing options, consider public transit, and rethink the expense of shipping goods by truck. Then, over time, people can shift their long-term plans by purchasing fewer cars or choosing vehicles with higher fuel efficiency.

Note that because of these behavioral changes, rising gasoline prices don't directly translate into increased costs for drivers. Many will drive less and therefore buy less gasoline. Others will be incentivized to purchase electric vehicles, which have lower fuel and maintenance costs.

In our moderate-growth scenario, total spending on gasoline rises roughly 4 percent in the early years; and by 2032 it is virtually unchanged, because at that point families have reset their driving and purchasing habits.

PRICE FLOORS AND CEILINGS

To protect against unexpectedly high auction prices — and similarly large fuel price increases — TCI's cap-and-trade program includes a price ceiling.

When prices threaten to rise beyond that level, emissions targets will be loosened to blunt further price increases. Note that there is a strict trade-off, where enforcing a price ceiling requires additional emissions. This process is managed via a "cost containment reserve," which lets program administrators inject new emissions allowances as needed.

A companion provision, called the "emissions containment reserve," works in the opposite way, tightening emissions targets when prices fall too low. As an example, if demand for motor fuels suddenly falls — as happened with the onset of Covid — emissions allowances can be pulled out of the market to help push prices back up. (Here the trade-off works in the opposite direction: prices rise, emissions drop.)

COMPLEMENTARY POLICIES

Alongside TCI, states may continue to pursue other policies that reduce emissions and address environmental justice — everything from vehicle regulations and pollution standards to new public transit.

We don't model these efforts, as they are not strictly tied to TCI, but they could have important implications for reducing transportation emissions.

IMPLEMENTATION

The Covid crisis has slowed, but not halted, progress toward TCI. Last December, the states issued a draft memorandum of understanding laying out the key goals and the basic mechanism.

A final memorandum of understanding is expected later this fall, with further details about which states plan to join the program, the carbon cap, and the price ceiling.

The current timeline envisions implementation beginning as early as 2022, a rapid pace that is helped by the fact that in some states — including Massachusetts — governors may have the authority to join TCI without legislative approval.

THE IMPACT OF TCI

ESTABLISHING A BASELINE

To gauge the impact of TCI, we need to know how gas prices and carbon emissions would evolve in the absence of TCI. That provides a baseline against which to assess the program's real-world effect.

We rely on various scenarios from the U.S. Energy Information Administration (EIA), which publishes

estimates of expected fuel usage and prices for New England and the mid-Atlantic regions.[3]

The agency's main projections, which form the basis for our moderate-growth scenario, suggest that emissions from gasoline and diesel consumption will decline roughly 14.2 percent between 2022 and 2032, irrespective of TCI. This reflects ongoing changes like increased use of electric vehicles and improved fuel efficiency.

Note, however, that these EIA estimates were made before the onset of Covid, and do not reflect its possible long-term impact on oil prices or economic growth.

Therefore, we also highlight an alternate that EIA calls its "Low Economic Growth" scenario, where the US economy underperforms for an extended period.

That case, while bad for businesses and personal incomes, is actually better for addressing global warming, as the reduced economic activity leads to a decline in emissions of 17.5 percent without any action by TCI.

In the appendix, we also include information about an additional scenario, where oil prices remain low, blunting incentives to purchase electric vehicles or drive less.

OUR RESULTS

In total, we generate 27 scenarios based on:

- Three different projections for economic growth and oil prices
- Three different emission targets
- Three different estimates for how TCI investments could impact demand for motor fuels

For each, we calculate the impact TCI will have on Massachusetts revenues, allowance prices, and gasoline prices in 2022 and 2032. The full results are included in the appendix.

Not all of our scenarios are equally likely. Here we present two central cases, which reflect some plausible choices and circumstances.

a) Moderate-growth scenario, with a 22 percent emissions reduction target by 2032 and a 1 percent annual demand reduction via investments

2022 Allowance Price (per metric ton)	**2022 Gas Price Increase** (per gallon)	**2022 Massachusetts Revenue** (millions)
$32	$0.24	$775

b) Low-growth scenario, with a 22 percent emissions reduction target by 2032 and a 1 percent annual demand reduction via investments

2022 Allowance Price (per metric ton)	**2022 Gas Price Increase** (per gallon)	**2022 Massachusetts Revenue** (millions)
$16	$0.13	$406

These tables show how prices would change in response to a 22 percent emissions reduction target for 2032. In our moderate-growth scenario, gas prices would increase by 24 cents per gallon in 2022. In our low-growth scenario, they'd increase 13 cents per gallon.

However, it's important to note that such price increases might not materialize because of the TCI price ceiling.

No decision has yet been made about where this ceiling will be set. However, an unofficial example was shared as part of a **September TCI webinar**, with a maximum allowance price of $14.[4]

If that ceiling were implemented, gasoline prices would not increase as much expected in our

central scenarios. Instead, allowance prices would remain at $14 and gas prices would be constrained to a level below what's needed to achieve a 22 percent reduction target.

The ultimate effect on emissions would depend on how long allowance prices remained at the ceiling, but in our moderate-growth scenario, a $14 price ceiling limits emissions reductions to 18.2 percent by 2032. In our low-growth scenario, emissions could fall by 21.5 percent.

Thinking more broadly about the full range of scenarios, there are a couple of key drivers to keep in mind.

Generally speaking, stiffer emissions targets lead to larger gas price increases and generate more state revenue.

For comparison, if the emissions target in our moderate-growth scenario were 25 percent — instead of 22 percent — then gas prices would rise 35 cents per gallon in 2022, and Massachusetts revenues would jump from $775 million to $1.1 billion.

Going the other direction, sound investments that effectively reduce fuel demand tend to dampen price increases. If the low-growth scenario had a 2 percent annual demand reduction via investments — instead of 1 percent — gas prices would only rise 10 cents per gallon.

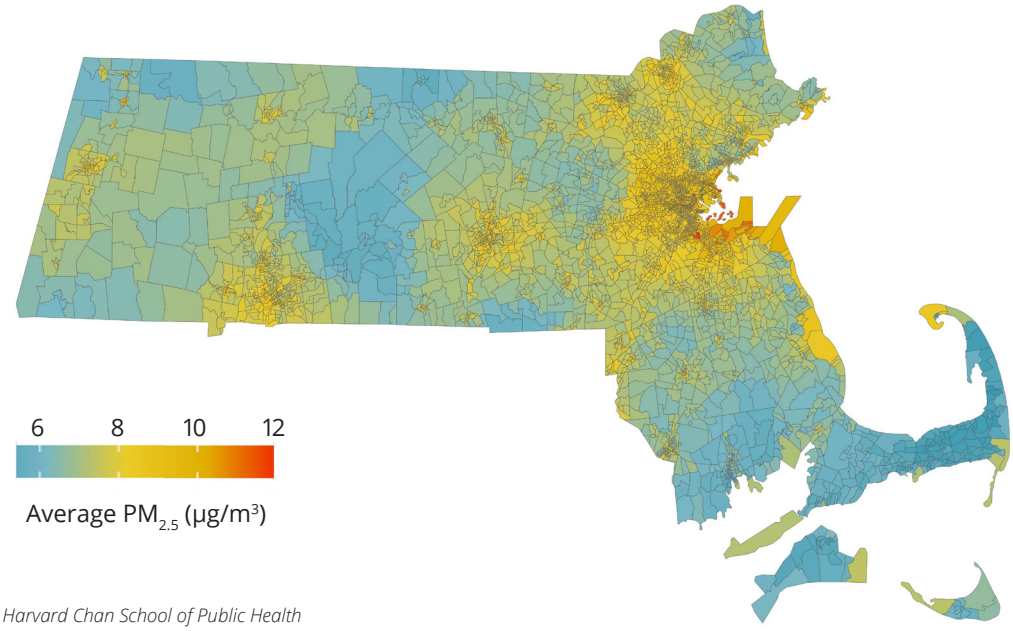
When estimating TCI revenues, there is one offsetting factor not included in our numbers. By encouraging people to drive less and switch to electric vehicles, TCI would reduce revenues from excise taxes. In a separate calculation, we find that these losses would offset roughly 4 to 5 percent of the revenue gains from TCI, though the interplay is complicated by the fact that excise taxes are generally used for different purposes.

REGIONAL IMPLICATIONS

The benefits — and costs — of TCI will vary across regions of Massachusetts.

Beyond the overall decline in emissions, perhaps the most dramatic benefit of TCI would be the reduction of local tailpipe pollution. Small, highly localized $PM_{2.5}$ pollutants — which are released in large quantities by combustion-powered cars and

FIGURE 1: AVERAGE $PM_{2.5}$ CONCENTRATION, 2010



Joel Schwartz, Harvard Chan School of Public Health

trucks — have been shown to cause asthma and other respiratory issues, along with cancer, heart disease, prenatal problems, and premature death.

As the Covid crisis has laid bare, these pollutants are especially concentrated in poorer, diverse cities such as Chelsea, Brockton, and Everett. Capping emissions from cars could thus have an especially beneficial impact in these and other low-income communities around Boston, Worcester, and Springfield. The map in Figure 1 gives a fuller sense of those regions with the highest $PM_{2.5}$ pollution.

In terms of direct impact, a preliminary analysis from the multi-university Transportation, Equity, Climate and Health (TRECH) Project found that the largest reduction in $PM_{2.5}$ would occur in and around Boston. It also estimates that a 22 percent emissions target would result in 210 fewer childhood asthma cases in Massachusetts in 2032.[5]

The geography is quite different when looking at the potential costs of TCI. Massachusetts' rural residents tend to be more car-dependent and less able to rely on commuter rail, subways, or buses. For this reason, they might be more vulnerable to the expected increase in gas prices.

Gas price increases also tend to affect poor families more acutely, as they spend a higher portion of their income on gasoline.

The map in Figure 2 accounts for both these factors, showing where gasoline comprises the biggest share of household budgets — chiefly in two vertical bands through Central and Western Massachusetts.[6]

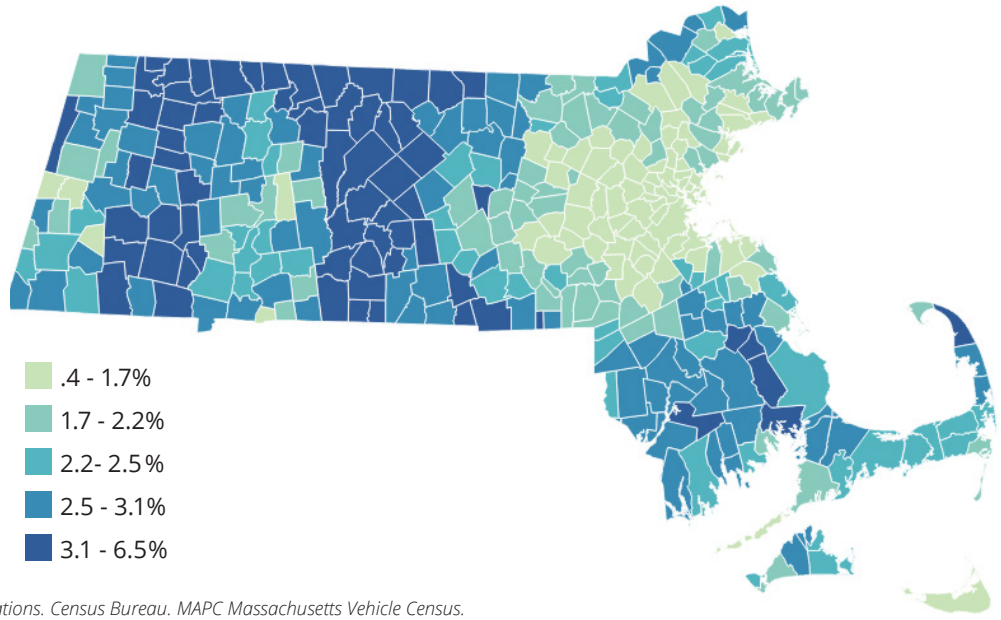
Note that spending on gasoline is a fairly small part of family budgets across Massachusetts, and would remain so even with TCI-related increases in the price of gasoline.

DIFFERENCES BETWEEN OUR RESULTS AND THE OFFICIAL MODELING

Our estimates of allowance prices, gas prices, and revenues from TCI tend to be higher than those in the modeling shared by the TCI initiative. For

FIGURE 2: GASOLINE SPENDING AS A SHARE OF HOUSEHOLD INCOME, 2014

Assuming gasoline costs of $2 per gallon



cSPA calculations. Census Bureau. MAPC Massachusetts Vehicle Census.

instance, in the central scenario of their model, a 22 percent emissions reduction is associated with a gas price increase of 9 cents per gallon in 2022, below both our central estimates.

One key reason is that the official modelers have a very different baseline. They expect emissions from motor fuels to fall 19 percent between 2022 and 2032, which is above our estimates of 14.2 percent (moderate-growth scenario) and 17.5 percent (low-growth scenario).[7]

This makes a big difference, because it means that in their modeling the TCI program wouldn't have to do as much emissions-reducing work to reach the overall targets of 20 percent, 22 percent, or 25 percent. As a result, the program would generate less revenue and smaller gas price increases.

Another important difference is the approach to investments. Whereas we use data on the actual impact of investments in California, they simulate the potential effect of a basket of investments — asking, for instance, what would happen if 30 percent of TCI revenue was spent on programs to encourage the use of electric cars, 23 percent for lower-emission buses and trucks, and 18 percent on the expansion of mass transit. Thinking of investments in this way gives a concrete sense of how the money could be used but may not reflect real-world spending priorities.

RISKS

While the cap-and-trade framework behind TCI is well-tested, there are a number of open questions and potential risks.

How rapidly will people's behavior change? Over time, higher gasoline and diesel prices should change people's driving and purchasing habits, but the precise pace of change is hard to predict.

Recent research has suggested that people are more responsive to changing gas prices than previously thought, and we base our modeling on this more optimistic assessment. Merely by demonstrating a multi-state commitment to put a price on carbon, TCI may spark a change in the way people think about their driving needs.

But if habits prove harder to break that could make TCI less effective. And there are still real barriers to widespread adoption of electric vehicles, like limited infrastructure for fast charging on long trips.

Will TCI revenues really increase spending on TCI priorities? There are two issues here. The first, noted earlier, is the fact that investment decisions will be made on a state-by-state basis, with few binding limits on how legislatures use this money.

Just as important, however, is the possibility that some TCI revenues will end up funding programs that would have happened anyway.

As an example, say TCI revenues in Massachusetts help to electrify the state's school buses. Before you attribute that investment to TCI, you need to be sure Massachusetts wouldn't have electrified its buses in a world without TCI. Otherwise, you can't really credit TCI with making this happen.

This is a well-known problem with government earmarks, known as fungibility. Commit all lottery revenue to education and the result isn't always an increase in education spending. Sometimes, the new lottery money merely allows lawmakers to stop dedicating other money to education, leaving schools in roughly the same budgetary spot.

Who will make spending decisions in Massachusetts? While it is widely accepted that the governor of Massachusetts has the authority to implement TCI's cap-and-trade mechanism without seeking legislative approval, the authority to spend TCI money **is a different issue**. State legislators can — and may well — **claim authority over this revenue stream**, giving them final say over any spending decisions.

And because of the fungibility issue noted earlier, even if the governor does end up controlling some

TCI spending, legislators could offset those choices by redirecting other funds away from TCI priorities.

Might drivers purchase cheaper gasoline elsewhere? Some TCI states will inevitably border non-TCI states, which could create perverse incentives for drivers to hop the border and fill up in non-TCI jurisdictions. This problem will be exacerbated if TCI ends up attracting a patchwork of states, rather than a contiguous region.

For passenger vehicles, the net effect will likely be small, as it is difficult to purchase sufficient gas to justify the cost of driving to a faraway station. For trucks, however, the concern is slightly greater, as long-haul vehicles can choose which states they frequent for fill-ups.

Given that Massachusetts has a **very low gas tax relative to its neighbors**, it's unlikely that the leakage effect will be particularly pronounced here.

Could drivers switch to different fuels? The TCI program only covers emissions from fossil fuels, meaning it exempts that portion of gasoline that is made from corn-based ethanol (usually 10 percent).

This creates a long-term incentive for fuel suppliers and drivers to switch to blends with higher amounts of ethanol as a way to avoid having to buy emissions allowances, even though the production of ethanol generates its own greenhouse gases.

However, the engines in most cars sold in the United States can't tolerate blends of gasoline with more than 10 percent ethanol (the so-called blend wall problem). So this would require automakers to sell more vehicles with ethanol-tolerant engines.

What about delays and disruptions? The TCI process has been moving swiftly, but a lot of the stickiest issues remain unresolved, including choosing an appropriate emissions cap and price ceiling. Any delay in implementation would also delay expected revenues, potentially pushing back plans for investment.

COMPLEMENTARY AND ALTERNATIVE APPROACHES

Several years have now been spent advancing TCI, including building public support, strengthening relationships among the states, and fine-tuning the approach. Expansions and alternatives that would require a collective step backward should not be undertaken lightly.

However, it's still worth considering the full range of potential tweaks, enhancements, and alternatives that could help address transport-related emissions and local pollution.

Link TCI with RGGI. The Northeast already has a cap-and-trade program covering emissions from power plants. From an environmental standpoint, there's little reason to keep them separate. The planet doesn't care whether carbon emissions come from power plants or cars, so the real imperative is to reduce emissions in toto, not sector by sector.

Linking TCI with RGGI could boost incentives in both marketplaces, effectively placing a unified price on carbon and allowing the market to dictate where the best opportunities for emissions reduction really lie. Such a linkage is in fact contemplated under TCI, at least as a future possibility.

On the downside, linking TCI with RGGI would add a layer of complexity to the already-difficult negotiations (not least because the mix of states is slightly different in the two programs). And it might muddy efforts to maintain separate revenue streams, with TCI money earmarked for transportation-related investments and RGGI dollars dedicated to energy-efficiency programs such as Mass Save.

Tighten regulations. In addition to pursuing TCI, Massachusetts could attempt to dictate terms to car manufacturers, power plants, and other key players in the carbon economy. California takes both approaches, with its own cap-and-trade program but also a set of fuel efficiency standards independent of the federal government.

Being a small state, however, makes it much harder for Massachusetts to set regulatory standards for national companies or global markets, not to mention the risk of legal challenge from companies that stand to lose under strict regulatory regimes.

Also, regulatory approaches often have **overlooked regressive effects**, which are harder to quantity than regressive taxes but just as damaging.

Study methods to support telecommuting. The Covid pandemic has dramatically curtailed driving, leading to shrinking emissions and reduced pollution. Helping workers and companies expand telecommuting options could lock in some of this decline in car dependence.

Given the suddenness of the crisis, however, little planning has been done on this front. The best next step may be a detailed analysis of the options for normalizing home-based work, perhaps in the form of tax breaks for telecommuters or congestion pricing for those still driving into high-traffic areas.

Participate in a far-flung emissions-reduction program. Should TCI negotiations break down, Massachusetts could instead partner with an existing cap-and-trade system, including the one for California and Quebec. However, if Massachusetts is the only Northeast participant it would raise the risk of leakage, as truck and car drivers could get non-carbon-priced gas in nearby states rather than filling up in Massachusetts.

Implement a carbon fee or carbon tax instead of TCI. From an economic perspective, cap-and-trade approaches such as TCI are actually very similar to direct prices on emissions. In one, you set a usage cap and watch the price adjust; in the other, you set a price and let usage adjust.

Massachusetts already has a robust system for tax collections on transportation emissions in the form of the gas tax, which would obviate the need to design a cap-and-trade regime.

Having said that, TCI may be politically simpler than a carbon fee, as it has substantial momentum and can potentially be implemented in some places (including Massachusetts) without legislative action.

CONCLUSION

Based on best available evidence, our analysis suggests that the TCI program could help reduce emissions and generate substantial revenue for participating states.

This revenue could be used to support green investments, promote environmental justice, and amplify the carbon-reducing impact of TCI. However, states will still have a lot latitude to set their own spending priorities. Data from California suggest that investments would have a real but limited impact on emissions.

By reducing other pollutants, TCI could also generate meaningful public health benefits, particularly in diverse neighborhoods near high-traffic cities.

The program would likely increase gasoline and diesel prices. In Massachusetts, these higher prices would be felt most sharply by lower-income, rural residents in central and western parts of the state.

TCI does have a mechanism to prevent large price increases via a price ceiling. However, this ceiling works by creating a direct trade-off, where price stability is ensured by allowing more emissions.

Among other things, the real-world impact of TCI will be shaped by the future of economic growth, global demand for oil, the cost of electric vehicles, the spending priorities of individual states, and the specific choice of price floors and ceilings.

From here to 2022, progress toward implementation could be swift, creating new urgency for discussions around costs and benefits, key choices ahead, and how states like Massachusetts can best use their TCI revenues.

APPENDIX: Impact of TCI on allowance prices, gas prices, and state revenue, 2022

Multiple scenarios for economic growth, oil prices, investment effectiveness

2022

20 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$25	$0.20	$650	$11	$0.09	$276	$24	$0.19	$623
1.0%	$22	$0.17	$555	$7	$0.06	$183	$22	$0.17	$553
2.0%	$18	$0.15	$460	$4	$0.03	$91	$19	$0.15	$483

22 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$34	$0.27	$868	$20	$0.16	$497	$31	$0.24	$780
1.0%	$31	$0.24	$775	$16	$0.13	$406	$28	$0.22	$711
2.0%	$27	$0.22	$681	$13	$0.10	$315	$26	$0.20	$642

25 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$47	$0.38	$1,191	$33	$0.26	$824	$40	$0.32	$1,012
1.0%	$44	$0.35	$1,099	$29	$0.24	$734	$38	$0.30	$945
2.0%	$40	$0.32	$1,007	$26	$0.21	$645	$35	$0.28	$877

Source: cSPA calculations. See Methodology.

Nearly all scenarios exceed the example price ceiling. The only exception is the slow growth scenario with two percent demand reduction via investments shown in blue.

APPENDIX: Impact of TCI on allowance prices, gas prices, and state revenue, 2032

Multiple scenarios for economic growth, oil prices, investment effectiveness

2032

20 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$41	$0.33	$862	$18	$0.14	$366	$39	$0.32	$830
1.0%	$35	$0.28	$742	$12	$0.09	$245	$35	$0.28	$744
2.0%	$30	$0.24	$620	$6	$0.05	$122	$31	$0.25	$655

22 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$55	$0.44	$1,129	$32	$0.25	$646	$50	$0.40	$1,018
1.0%	$50	$0.40	$1,015	$26	$0.21	$532	$46	$0.37	$936
2.0%	$44	$0.35	$899	$20	$0.16	$416	$42	$0.33	$852

25 Percent Emission Reduction Target									
Investment Impact on Demand	Moderate Growth			Slow Growth			Low Oil Price		
	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*	Allowance Price *2019 USD per metric ton*	Gasoline Price Increase *2019 USD per gallon*	MA Revenues *2019 USD*
0.0%	$77	$0.61	$1,498	$53	$0.43	$1,037	$65	$0.52	$1,277
1.0%	$71	$0.57	$1,394	$48	$0.38	$932	$61	$0.49	$1,202
2.0%	$66	$0.53	$1,288	$42	$0.34	$825	$57	$0.46	$1,125

Source: cSPA calculations. See Methodology.

Nearly all scenarios exceed the example price ceiling. The only exception is the slow growth scenario with two percent demand reduction via investments shown in blue.

Methodology

OVERVIEW

Using gasoline and diesel fuel projections from EIA under three different economic scenarios, we calculate the allowance price required to reduce demand at the end of 10 years by 20 percent, 22 percent, or 25 percent from 2021 levels in 2032. We assume the allowance price is fully passed forward to consumer prices and so raises gasoline and diesel prices from the projected price level in each EIA scenario. We then apply a price elasticity of demand to estimate the reduction in fuel consumption in that year.

Our analysis assumes 10 percent of blended gasoline is ethanol that is exempt from TCI coverage. After calculating the allowance price required to achieve a given emissions reduction target, we calculate the revenue from auctioned allowances. We also make a separate calculation to reflect reductions in state gasoline and diesel-motor fuel excise-tax revenue.

We further assume that allowance prices will rise at 5 percent per year to reflect the impact of banking.

KEY ECONOMIC PARAMETERS

Price elasticity of demand. For gasoline, we set the elasticity in the first year of analysis, 2022, to a value of -0.3. The elasticity in the 10th year of analysis, 2032, is set to a value of -0.8 (see sources **one** and **two**.) For each intervening year, the elasticity is assumed to grow linearly from the short-run value to the long-run value.

We employ a similar procedure for diesel fuel using a short-run estimate of -0.06 and a long-run estimate of -0.12 (drawn from **this paper** and unpublished work by the same author.)

Impact of green spending. Absent microeconomic data on the demand-reducing impact of spending programs from TCI revenue, we run scenarios with different assumptions about demand reduction, based on the marginal cost of abatement and emission reduction possibilities included in the 2020 California Climate Investments Annual Report on Cap-and-Trade Auction Proceeds.

We take marginal abatement costs and emission reductions for transportation initiatives funded by California cap-and-trade auction revenue and sort them from least expensive to construct marginal abatement curves.

Assuming allowance prices of $100 or less, publicly funded projects reducing up to 0.2 percent of emissions would be cost effective, assuming a comparable marginal abatement cost (MAC) curve for the TCI region as for California. It is possible that emissions could be reduced through green spending that has higher MACs than $100 per ton. California cap-and-trade auction revenue allocated to transportation funded projects implemented in 2018 are estimated to have cut transportation emissions by less than 1 percent annually.

DATA

We use data from the U.S. Energy Information Association's (EIA) 2020 Annual Energy Outlook (AEO) for the following economic scenarios: Reference (which we call "moderate growth"), Low Oil Price, and Low Economic Growth. The scenarios are described in **AEO's Case Descriptions**.

Data are downloaded from **EIA's data browser** for the following:

- Regional projections of motor gasoline consumption from 2019-2050 in New England (EIA) and Middle Atlantic (EIA) transportation sector (quads).
- Regional projections of motor gasoline price from 2019-2050 in New England (EIA) and Middle

Atlantic (EIA) transportation sector (US $/MMbtu). EIA refers to Distillate Fuel Oil as on and off road diesel consumption.

- Regional projections of on-road diesel consumption from 2019-2050 in New England (EIA) and Middle Atlantic (EIA) transportation sector (quads).

- Regional projections of diesel price from 2019-2050 in New England (EIA) and Middle Atlantic (EIA) transportation sector (US $/MMbtu).

The analysis includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. It excludes TCI jurisdictions in the South Atlantic region: Maryland, Virginia, Delaware, and Washington, D.C.

APPROACH TO CALCULATIONS

Building off this data, we use Excel's Solver module to determine what allowance price would be required to hit certain reduction targets, assuming a 5 percent annual growth in allowance prices from 2022 through 2032.

Once that's calculated, the allowance price can be converted to a gasoline price increase, accounting for the fact that 10 percent of blended gasoline is ethanol.

Using year-by-year elasticities, we calculate new gasoline consumption using reference gas consumption and the following formula: $\Delta Q/Q = \Delta P/P^*(\varepsilon^D)$ where ε^D is the price elasticity of demand for gasoline, ΔQ is the change in consumption, and ΔP is the change in price.

The new gas price is the reference gas price plus the gas price increase. The assumed gasoline-based emissions reduction from TCI investments is calculated by multiplying gasoline consumption by the relevant adjustment. TCI allowance revenue from gasoline is the product of the allowance price and emissions from gasoline.

Similar calculations are done for diesel consumption. Total emissions reductions are equal to gasoline and diesel emissions relative to emissions in 2021.

Total revenue is the sum of revenues from the two sources. We calculate this at the TCI regional level and allocate revenue to Massachusetts based on its share of fuel consumption in the region (EIA).

The reduced gasoline and diesel consumption also affects motor vehicle excise-tax revenue. To compute the total regional excise-tax revenue loss, we compute a weighted (by consumption) average excise tax on gasoline and diesel separately using excise-tax data from the Tax Policy Center, adjusting for the fact that the tax does not apply to ethanol.

Similarly, we compute the excise-tax revenue loss in Massachusetts by estimating the proportion of regional gasoline/diesel consumption that comes from Massachusetts.

Endnotes

[1]In addition to Washington, D.C., the states involved in TCI negotiations are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.

[2]In their **public comments on the TCI initiative**, suppliers state: "To be 100% clear, and eliminate any confusion, these costs, and the costs necessary to comply with this program by regulated entities will be reflected in retail motor fuel prices that consumers pay."

[3]The area we model — covering New England and the mid-Atlantic states — approximates but does not perfectly match the proposed TCI region, which also includes jurisdictions in the South Atlantic, namely Maryland, Virginia, Delaware, and Washington, D.C.

[4]Following the example from the TCI webinar, we assume this price ceiling would rise 5 percent per year through 2032.

[5]The TRECH study uses one of the investments scenarios included with the official TCI modeling. See "Differences Between Our Results and the Official Modeling."

[6]Figure 2 uses detailed data on driving habits assembled by the Metropolitan Area Planning Council.

[7]Among other things, the official TCI modeling assumes that electric vehicle costs will be lower than EIA projects.

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