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Introduction

My name is Charles Komanoff. I am a policy analyst specializing in urban transportation.[1] In earlier periods in my career I have been an air emissions researcher; an electricity-system analyst; an investigator of cost escalation in the U.S. nuclear power industry; an expert witness for staffs of public utility commissions and consumer advocates representing electricity customers in a dozen U.S. states including the four largest; a researcher and analyst of urban bicycle transportation; and a developer of economic models tracing changes in energy usage and travel behavior to changes in energy and transport prices. I maintain a personal and professional interest in most of these subjects.

I have also been an advocate and activist in many of these subject areas. I led and revitalized New York's bicycling-advocacy NGO Transportation Alternatives from the mid-1980s to the early-1990s. I later spearheaded the activist collective Right Of Way in campaigns that fused data analysis and guerrilla art to draw attention to rampant traffic violence on the streets of New York. I co-founded and today run the Carbon Tax Center, an NGO that urges robust carbon pricing to combat climate change. And as both pamphleteer and modeler I am a mainstay of the campaign to institute a congestion pricing program in New York City's central business district, or CBD. (The broad outline for that program was established in 2019 state legislation authorizing the state Metropolitan Transportation Authority to toll motor vehicle trips into the CBD; startup is anticipated in mid-2024.)

Brief Summary

Expanding Toronto's fleet of ride-hail vehicles will worsen traffic and air quality, even if the increase takes the form of electric vehicles rather than traditional internal-combustion vehicles. The magnitude of these harms will depend on the net number of the additional vehicles and the prevalence of traffic congestion in the areas where the vehicles will be operated.

Conversely, *replacing* some of Toronto's internal-combustion ride-hail vehicles with electric ride-hail vehicles will reduce emissions and improve air quality, provided that this is done without increasing the total number of ride-hail vehicles in the city.

Context

Over the past decade-and-a-half I have developed and curated an extensive model, implemented in Microsoft Excel, that captures New York City's and the surrounding metropolitan region's traffic and transportation characteristics including hourly and daily car and truck trips, transit trips, use of for-hire vehicles, and the ease or difficulty of "mode shifting" between and among these travel modes.

[1] My professional biography is available via https://www.komanoff.net/komanoff_bio.pdf or at this link.

This model, known as the Balanced Transportation Analyzer or BTA, was employed by the NY governor's executive staff to scope congestion tolling during the 2017-2018 run-up to the drafting and passage of the 2019 authorizing legislation to which I alluded above.[2]

The BTA is vast in scope; at this writing it has some 160,000 equations.[3] Its versatility and ease of use qualify it to analyze many traffic and transportation policies and proposals apart from congestion pricing. Among its attributes is that it can translate "exogenous" or other policy-driven changes in traffic volumes into expected changes in traffic speeds within the Manhattan CBD as well as in adjacent areas. Those predicted changes in vehicle travel speeds in turn produce prospective changes in daily and annual tailpipe and other vehicle emissions, reflecting the general tendency of vehicular emissions to worsen as travel speeds diminish and stop-and-go driving predominates.

How I modeled traffic and emissions consequences of exempting EVs from New York's FHV cap

In October 2023, the New York Taxi and Limousine Commission (TLC) exempted[4] electric-propulsion vehicles (EVs) from a citywide cap on the number of permitted ride-hail vehicles.[5]

Using the BTA, I undertook to analyze the extent to which the resulting increase in vehicles operating in New York's Central Business District and elsewhere in the city would be expected to slow traffic movement and impose time losses on drivers. I also estimated emissions impacts and other externality costs in the city and region resulting from the increased miles driven.

At the time I performed that analysis — and probably today as well — some 80,000 ride-hail vehicles were operating regularly in New York City's five boroughs, out of a total permitted number of around 90,000.[6] I did not attempt to estimate how many additional ride-hails would seek and receive permits and enter regular use in response to the TLC's waiving its cap for electric ride-hail vehicles.

Instead, I assumed that the TLC cap exemption would cause 5,000 more ride-hail vehicles to operate in New York City. I treated the 5,000 figure as a "placeholder" and emphasized that the calculated impacts would "scale" linearly (proportionally); for example, the expected congestion and emission harms from 10,000 vehicles would be approximately twice as great as for the 5,000 vehicles that I assumed.

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[2] The BTA model was warmly acknowledged in the appendix to the "FIX NYC" report from NY state's transportation-modeling consultant, which can be downloaded via this link or perused in the **About** tab of the BTA spreadsheet.

[3] The BTA is in the public domain, with the current version always available at this link: http://www.nnyn.org/kheelplan/BTA_1.1.xls,

[4] See *NY Post*, Oct. 19, 2023, NYC lifts cap on for-hire cars — provided they're electric.

[5] New Yorkers use the term "ride-hail" to denote Ubers and other vehicles that riders summon via digital apps. Ride-hails and traditional yellow taxicabs together are referred to in New York as for-hire vehicles (FHVs).

[6] In addition to ride-hail vehicles, on an average day an estimated 10,000 to 11,000 taxicabs operate in NYC, out of a licensed total of around 13,500. Taxicabs operate predominantly in the Manhattan CBD whereas ride-hails are more evenly distributed through the five boroughs.

Modeling traffic slowdowns from additional vehicles

I calculated the slowdown in New York's traffic flow from an additional 5,000 ride-hail vehicles as follows. First, I assumed that each additional vehicle would be driven the same number of miles as "incumbent" ride-hail vehicles, and in the same geographical and hourly distribution. This yielded increased vehicle-miles traveled (VMT), divided up among the different periods of the day and proportioned between the CBD and the region outside the CBD. (A more detailed methodological description appears further below.)

I then inputted — I should say that *the model* inputted — the fractional increase in VMT in each period due to the additional vehicles into a pair of equations that convert changes in traffic volumes (actually, traffic *density*) into changes in traffic speeds. One equation applies to CBD streets and roads, while the other applies to roads and highways outside the central district. This step yielded the decreases in driving speeds and the corresponding lengthening of driving-trip durations precipitated by the assumed 5,000 increase in ride-hail vehicles.

Modeling the emission increases caused by the traffic slowdowns

Two motor vehicle pollutants dominate public health and policy concerns about automotive emissions: fine particulates (PM2.5), the air pollutant most damaging to human health; and carbon dioxide (CO2), the primary atmospheric pollutant destabilizing Earth's climate.

The BTA is stocked with per-mile "emission factors" for PM2.5 and CO2 for the several dozen major classes of motor vehicles ranging from light-duty gasoline vehicles and light-duty electric vehicles to so-called light trucks and increasingly large (and higher-emitting) commercial-grade trucks. Roughly twice each decade, these emission factors are meticulously measured at 5 mph increments from zero to 80 mph by the California Air Resources Board (CARB), the world's foremost air pollution control agency. Emission rates per mile typically are highest (i.e., worst) at very low driving speeds; they are also high at very high speeds, with a long trough of lower emissions at "moderate" driving speeds of around 30 mph.

Several years ago, as part of my periodic updating of the BTA, I converted the CARB data ("parametrized" is the technical term) into emission curves as a function of vehicle speed, for each relevant vehicle type. The model employs these curves to calculate changes in per-mile emissions due to changes in vehicle speeds, for each category of vehicle driven in the New York City region. The model also contains estimates, drawn from agency data, of the various vehicle categories' shares of miles driven in and around New York City. In much less time than it takes to explain, the BTA calculated the increases (yes, typically the changes worsen emissions) in hourly, daily and yearly emissions of fine particulates and carbon dioxide stemming from the slight but non-zero slowing of traffic caused by the hypothesized addition of the new electric vehicles.

Modeling direct PM2.5 emission increases from the additional EVs

I made sure, in my emissions calculations for New York, to set tailpipe emissions to zero for the miles driven by the new electric vehicles. I did, however, apply CARB emission factors for the on-road particulate matter generated from the electric vehicles' tire and brake wear. Not only are these "abrasive" PM2.5 emissions from EVs *not* zero; they are greater, per mile, for EVs than for similar conventional combustion vehicles, on account of the EVs' generally greater weight.

Nevertheless, electric vehicles are less polluting at ground level — on the streets and roads where they operate — than equivalent combustion vehicles. Accordingly, *replacing* combustion vehicles with electric ones (rather than *adding* them) will diminish on-road emissions of fine particulates and other pollutants that damage human health.

New York modeling results

Below are the primary results from my modeling last fall of adding 5,000 electric ride-hail vehicles to New York City's traffic mix. These results need to be caveated for Toronto citizens and officials, on two grounds: They apply to New York, whose traffic volumes and patterns differ from Toronto's. And they arise from a specified number of additional electric ride-hail vehicles (five thousand) that was assumed rather than derived from an analysis (which I did not perform) of lifting an EV cap.

With those caveats, my key New York modeling results for 5,000 additional ride-hail EVs are as follows. (The list is adapted from my Nov. 6, 2023 affidavit in an "Article 78" petition by the New York Taxi Workers Alliance seeking to compel the Taxi and Limousine Commission to suspend permitting additional electric ride-hail vehicles until it has performed an environmental assessment.[7])

Projected impacts of adding 5,000 electric ride-hail vehicles to New York City

- Reductions in average daily and annual vehicular travel speeds of a little over 2% within the CBD (which, again, is all of Manhattan south of 60th Street), and 0.3% across the rest of the metropolitan region;
- Nearly six million more hours per year spent stuck in traffic by motor vehicle users in the region, which equates to more than $200 million per year worth of lost motor vehicle travelers' time;
- Additional emissions of climate-destabilizing carbon dioxide of 35,000 metric tons per year, the societal cost of which is approximately $3.5 million per year, based on a mid-range estimated "social cost of carbon" of $100 per metric ton of CO_2;
- Additional emissions of human health-damaging fine particulates (PM2.5) of 1,100 kilograms per year, the societal cost of which is approximately $5 million per year worth of additional illnesses, school absences and emergency room visits;
- Increased motor vehicle crashes on account of the overall increases in vehicle volumes, with expected injury-related costs of $40 million per year;
- Reduced quality of life for people in the city and region, costing $45 million per year, primarily from reduced engagement in healthful "active transportation" (cycling and walking), owing to worsening traffic volumes.

[7] My affidavit in the Article 78 petition was sponsored jointly by Reinvent Albany, a statewide New York "good-government" group, and the taxi workers alliance mentioned in the text. It may be downloaded via this link to my website. Note that on Nov. 8, 2023, a NY state judge ordered the TLC to suspend permitting of additional electric vehicles. According to a local news site, the TLC said that in the brief period from lifting the cap to the judge's order, the agency received 1,746 applications for new electric for-hire vehicle licenses. See *Gothamist*, Nov. 9, 2023, Judge blocks NYC's plan to lift cap on electric for-hire vehicles.

Key assumptions in deriving the New York results

Following are important assumptions I made in analyzing the impacts of adding 5,000 electric ride-hail vehicles to New York's traffic mix:

- I assumed a net increase of 5,000 in the number of ride-hail vehicles. All of these vehicles are entirely battery-powered and thus have zero tailpipe emissions.
- Each additional vehicle is driven an average of 42.6 miles per weekday, of which 26% (11.2 miles) are traveled within the Manhattan CBD and the remaining 74% (31.4 miles) are traveled outside the CBD. (Analogous mileages on weekends and holidays are 46.8 total, 12.3 CBD and 34.6 outside CBD.)
- These additional daily ride-hail miles fall into the 24 hours of the day in the same proportions as previously permitted Ubers and Lyfts. (These distributions are flatter than private car use patterns.)
- The 5,000 vehicles' additional daily ride-hail miles — which sum to 213,000 miles on weekdays and 234,000 on weekends and holidays — create incremental traffic congestion which the BTA model converted to reductions in prevailing travel speeds both within and outside the CBD. These reductions were slight for each individual vehicle but consequential in the aggregate, on account of the sheer numbers of drivers and passengers of cars, vans, trucks, buses and for-hire vehicles operating in the city and region.
- The reductions in travel speeds converted to increased (i.e., worsened) travel times for all motor vehicle users both within and outside the CBD. They also lead to increased per-tailpipe emissions from those vehicles, on account of the general worsening of emission outcomes as traffic levels rise and stop-and-go conditions become more prevalent. Just like the travel delays, these increases in tailpipe emissions are slight for each vehicle but consequential in the aggregate.
- I assumed throughout my modeling a "rebound effect" by which increased crowding of New York roadways prompts a sympathetic reduction in other vehicular traffic, as some automobile trips lose utility to their takers on account of increased travel times. This rebound effect, though less than 1-for-1, constituted a conservatism (leading to lesser estimated impacts) in my analysis.
- The calculation of tailpipe emissions under the "new" conditions, with baseline traffic levels augmented by the 5,000 new electric ride-hail vehicles, was adjusted to eliminate all of the miles driven by those vehicles, in order to reflect their on-road zero-tailpipe-emission character.
- Nevertheless, the new ride-hail EVs generate on-road emissions of particulates, including fine particulate matter (PM2.5), through tire wear and brake wear. These emissions were duly counted in my modeling calculations and included in my numerical findings.
- My New York analysis included the new ride-hail EVs' "upstream" emissions of CO_2 through the additional generation of electricity required to recharge them, which I calculated assuming that all of the incremental kilowatt-hours of electricity required for charging these EVs would be generated by burning methane gas, reflecting the downstate NY grid's nearly total reliance on fossil fuels. The resulting annual charging-related CO_2 emissions from the grid, 11.2 metric tons, increased by nearly 50 percent the 23.7 metric tons of new tailpipe CO_2 emissions estimated separately from the incremental worsening of travel speeds for the hundreds of thousands of combustion vehicles in the city and region, stemming from the additional 200,000 or more daily miles of travel by the 5,000 new EV ride-hails.
- I did not include additional emissions of "local," health-damaging PM2.5 from the electricity smokestacks, in order to steer clear of the many assumptions that would be required and to avoid complications from combining smokestack-level impacts with tailpipe ones.

Applying my New York analysis to Toronto

The mapping and navigation company firm Tomtom last month released data indicating that in 2023 Toronto was the world's 3rd-most traffic-congested city out of 387 global cities. The average Toronto "City

Center" driving speed during rush hours was reported to be 18 km/hr, equating to 11 mph.[8] Unsurprisingly, the city's dismal showing was widely reported in Canada.[9]

Also striking was that Toronto fared worse than notoriously gridlocked New York City, which the Tomtom survey ranked 20th-worst for congestion. New York's average rush-hour speed was given as 20 km/hr (equivalent to 12.2 mph), around 10 percent higher than Toronto's.

There may be an apples-to-oranges aspect to the Tomtom traffic-speed figures, however. Both of them are for "City Center," and, thus, may be meant to cover Toronto city, with an area of 243 square miles, and New York City, with 300 square miles.[10] Yet New York parlance does not usually speak of a "city center"; rather, there is a Central Business District, comprising just 8 or 9 square miles. The average daytime vehicle speed there, covering the long daytime 8 am – 6 pm period, was officially estimated, pre-pandemic, to be 7 mph,[11] a whopping 40 percent worse than the Tomtom figure. (Local authorities do not report average vehicle speeds for the entire city.[12]) Further complicating the picture, it isn't immediately clear what times of day Tomtom's "rush hour" covers.

Nevertheless, the imperfect correspondence between the two cities shouldn't preclude Toronto officials' using my New York analysis of additional electric ride-hail vehicles to obtain order-of-magnitude results for Toronto. The 5,000 additional vehicles I hypothesized for New York would, I estimated in my affidavit, add approximately 1% to miles driven within the Manhattan CBD, and 0.1% to miles driven in the larger, surrounding metropolitan region. Through judicious extrapolations — not between the two cities' respective numbers of electric ride-hail vehicles[13] but between current VKT levels in Toronto and the prospective increases from permitting additional ride-hails — it should be possible to tease out estimates of the speed losses (in percentage terms) and time losses (in thousands of hours per year) caused by expanding Toronto's ride-hail fleet. I would be pleased to assist Toronto city staff in such an effort.

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[8] See Jan. 2024, Tomtom Traffic Index, Ranking 2023.

[9] See for example, *National Post*, Jan. 11, 2024, Toronto ranked third worst in the world for time stuck in traffic.

[10] Both area figures are from Wikipedia. New York's explicitly excludes water. Toronto's probably does as well.

[11] The 7 mph figure for New York's CBD was calculated with 2018 GPS records maintained by NYC medallion taxicabs, and was distilled and reported in NYC DOT, New York City Mobility Report (August 2019), pp 18-19. In my post-pandemic versions of the BTA, including the current one, I raised the 7 mph figure to 7.5, in a nod to anecdotal appearances that CBD traffic today is slightly less congested than before the pandemic.

[12] It may be of interest that Toronto's and New York City's relative congestion rankings in Tomtom's survey are reversed for "Metro areas."

[13] Toronto has perhaps 15,000 ride-hail vehicles, based on City of Toronto, "Update on Outstanding Vehicle-for-Hire Directives," Nov. 16, 2021, p. 27. ("The average number of daily active PTC [spell out] vehicles has been between 12,500 and 14,500 since July 2020, and is currently around 13,500.")