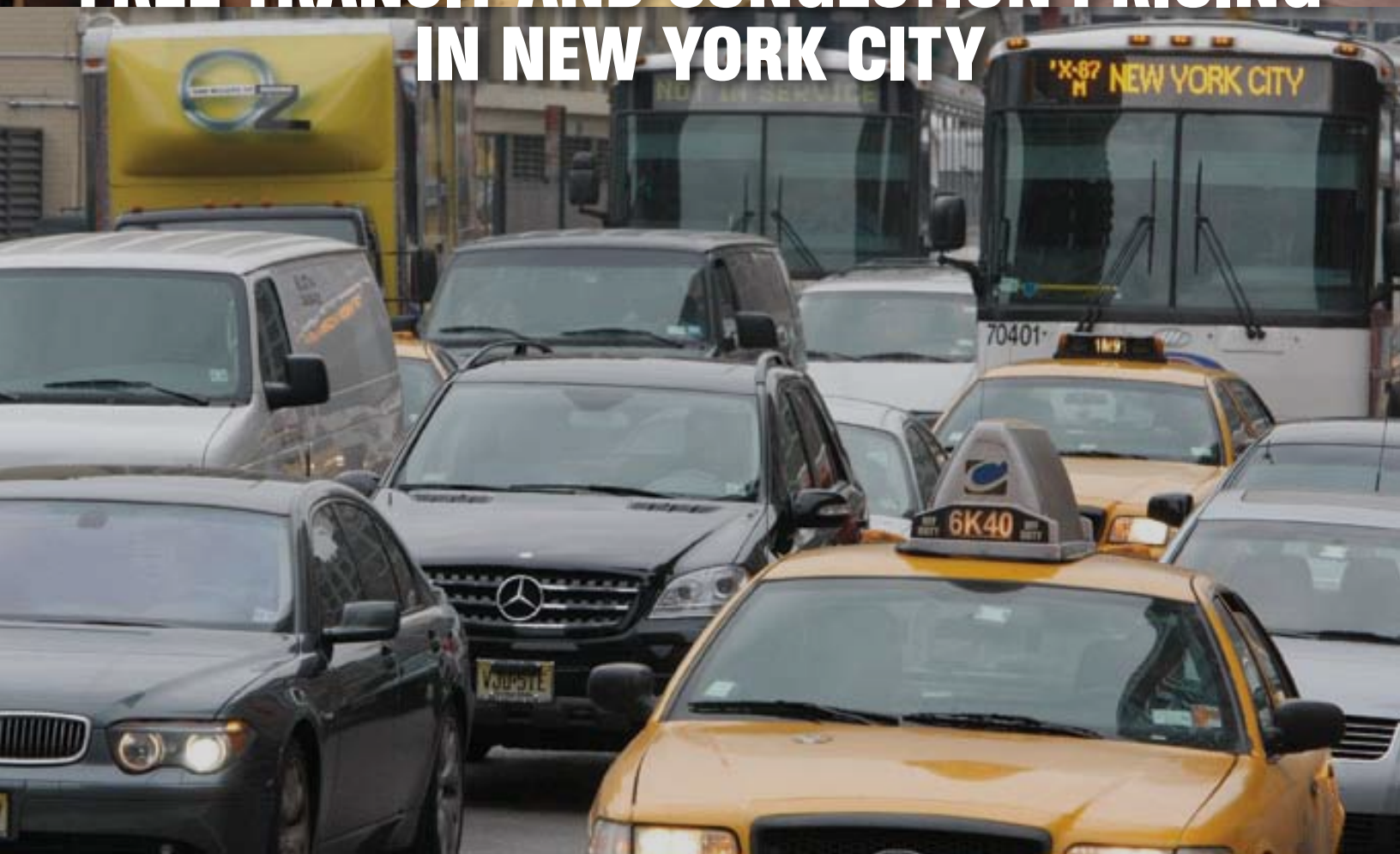
A BOLDER PLAN

BALANCING

FREE TRANSIT AND CONGESTION PRICING IN NEW YORK CITY



THEODORE W. KHEEL

Theodore W. Kheel has had a long and distinguished career in conflict resolution. For half a century, he applied his extraordinary genius for resolving conflicts to the field of labor relations and related societal concerns. Over the past two decades, his primary focus has been on addressing what he calls "the most urgent conflict facing humanity today," the conflict between economic development and environmental protection.

In the field of labor relations, Kheel has settled some of the most intractable disputes of the 20th Century. The New York Times declared him "the most influential peacemaker in New York City in the last half-century," and Business Week dubbed him "Master Locksmith of Deadlock Bargaining." He has been called on by presidents, governors, and mayors to act as a mediator or serve on fact-finding boards. Kheel has also arbitrated thousands of disputes.

Kheel has often applied his skills at finding solutions not only to specific disputes but also to broad societal issues, such as civil rights. He was influential in that movement in the 1950s, as chairman of the National Urban League, and in the 1960s, when he continued to work with civil rights leaders, including most notably the Rev. Martin Luther King, Jr.

Beginning in the early 1990s, Kheel became deeply concerned about the future of the planet, and began dedicating his energy and talent to the cause of sustainable development. He founded and published the Earth Times, the prime source of information pertaining to the Earth Summit and the treaty on climate change signed there. Later, he founded several nonprofits dedicated to helping reconcile the conflicting goals of development and conservation: the Nurture Nature Foundation **(http://nurturenature.org)**, Nurture New York's Nature **(http://nnyn.org)**, and Earth Pledge **(http://www.earthpledge.org)**. Kheel also helped to create a 1,500-acre ecological reserve in the Dominican Republic, and to found a pioneering Ecological Foundation there **(http://puntacana.org).**

Kheel has long been an advocate of mass transit as a sustainable solution for transportation in cities. His involvement with transit began in the 1940s, when he directed New York City's Labor Relations Division. After he left city government, Kheel was asked to serve as mediator whenever a transit strike was threatened, and was the industry's impartial arbitrator for many decades.

Already in the early 1950s, Kheel was calling for increased public support for mass transit as a way to curb growing traffic congestion. In 1958, he issued a report that received widespread attention, in which he criticized a law that required transit operations to be maintained on a self-sustaining basis.

Photo: courtesy of Kheel family

In the 1960s, Kheel made headlines when he urged that tolls charged to drive cars into the city be doubled, and the proceeds used to help the struggling transit system. Although attacked vehemently at the time, his ideas were implemented, in large part, by the end of the decade.

The exception was the Port Authority, which claimed that it was prohibited by law from using toll revenues to support mass transit. As a result of that law, Kheel's campaign to have the Authority use its tolls for mass transit took longer. Although he succeeded in having the law repealed in the 1970s, the full benefit of his efforts were not harvested until 2007, when the bonds issued prior to the law's repeal finally matured.

Kheel has engaged in many other activities in support of mass transit, including a widely-covered campaign during the 1970s to defeat a transportation bond issue that allocated vast funds to highways and little for mass transit. In 2007, he initiated this study of the potential of free transit to create a better balance in transportation in New York City.

Mr. Kheel graduated from Cornell University, A.B. 1935, and Cornell Law School, LLB 1937. He is a member of the New York Bar Association, the American Arbitration Association and the Academy of Arbitrators, and is of counsel to Paul, Hastings, Janofsky & Walker LLP. Kheel has summarized his views on the basic principles of conflict resolution in his book, "The Keys to Conflict Resolution," and in an online course at **http://conflictresolution.org**. He is also the author of a 10-volume treatise entitled "Kheel on Labor Law." His historic archives are collected at the Kheel Center at Cornell's School of Industrial and Labor Relations **(http://www.ilr.cornell.edu/library/kheel)**.

NURTURE NEW YORK'S NATURE INC.

To Mayor Bloomberg and Governor Spitzer:

I am directing this report, "Balancing Free Transit and Congestion Pricing," to you, two courageous reformers, who are the transportation policy makers for our city and the political leaders of the people who live here. I am presenting to you as well an analytic tool, which we have dubbed the Balanced Transportation Analyzer (BTA) (available on our website, at http://nnyn.org/kheelplan), that could fundamentally transform the way these twin issues are evaluated.

When you spoke in Bali in December, Mayor Bloomberg, you brilliantly expressed why sustainable transportation policies are so important to our cities, and why sustainable cities are so critical to our planet's future. And you explained how congestion pricing was a crucial step in making cities across the world functional and sustainable. Earlier last year, you acknowledged that "If you were to design the ultimate system, you would have mass transit be free and charge an enormous amount for cars."

The plan that is set forth in the following pages is that ultimate system, and the BTA we developed to build that plan shows it is feasible.

The fundamental principle behind the plan is that car travel and mass transit are interrelated, like two sides of an equation, two weights counterpoised on a scale. Ideally, there should be a balance, but instead, our system is enormously, unconscionably out of balance. This report shows how we can correct that.

Both of you have supported congestion pricing. You recognize that charging a fair price for automobile travel can diminish the awful gridlock in our city and in other cities worldwide. Yet you both support fare hikes for mass transit, a policy that drives commuters back to the car, effectively nullifying the very result you are seeking to achieve through congestion pricing. This is not sound policy.

[continued on next page]

Nearly three and a third billion men, women and children, half Earth's population, live in cities. Eight and a quarter million live in New York. We owe it to the people of this city and to those across the world to begin fashioning a balanced system for getting around our urban areas.

I said that I was addressing this report to you not only as policymakers, but also as the political representatives of the people.

In December, I sent a preliminary version of this report to the members of the New York Traffic Congestion Mitigation Commission and the board of the New York City Metropolitan Transportation Authority. Neither body modified its course of action in response. Indeed, the MTA proceeded with its fare increase.

Polls have shown consistently that voters are far more disposed to favor congestion pricing if it is paired with fare relief. Imagine, then, what New Yorkers will say when asked how they feel about congestion pricing coupled with the ultimate form of fare relief — a reduction of the fare all the way to zero. This more balanced plan will result in the equivalent of a $20 after-tax pay raise for every transit-using worker in the city. Automobile drivers will benefit too, as traffic is vastly reduced.

Once commuters grasp the potential, I believe they will not only approve of, but insist on, the balanced system that I propose.

I hope that the Traffic Commission and the MTA will come around to my point of view. If they do not, however, I will do whatever I can to see that New Yorkers have an opportunity to express an opinion on the issue through their vote in future elections. I hope the two of you will support me in that endeavor. This is a vital issue, and one whose time has come.

A BOLDER PLAN:

BALANCING FREE TRANSIT AND CONGESTION PRICING IN NEW YORK CITY

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A digital copy of this report may be viewed and downloaded from www.nnyn.org/kheelplan.
That page also contains a link to the Balanced Transportation Analyzer —
the spreadsheet model supporting the research and findings in this report.

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"For more than half a century, I have tried to focus New Yorkers' attention on the fact that car travel and mass transit are two halves of a whole, the yin and yang of traffic. You can't consider one without the other."

— Theodore Kheel,
The Daily News, Jan. 10, 2008

THE KHEEL PLAN: FREE TRANSIT, FREE NEW YORK

Introduction

Traffic congestion is strangling New York, costing our city $13 billion a year in economic losses and causing enormous environmental pollution and stress. Various proposals, including Mayor Bloomberg's PlaNYC congestion pricing scheme, have been put forward to curb traffic gridlock, against the backdrop of steadily rising fares for mass transit users. However, none of these proposals include fare relief as a component, even though the price of mass transit, like the price of driving a car, has a big impact on traffic congestion.

This study seeks to answer the provocative question: **Could we solve the city's traffic problems by pairing congestion pricing for cars with the ultimate in fare relief — elimination of fares to ride New York's subways and buses?**

Commissioned by veteran transportation advocate Theodore Kheel, the study examines the feasibility and quantifiable benefits of a proposed plan (hereafter referred to as the "Kheel Plan") that would permanently eliminate New York City subway and bus fares and offset the loss of income with a combination of: 1) a 24-hour $16 toll on autos and $32 on trucks crossing into Manhattan's most congested area, the Central Business District (CBD) at or below 60th Street; 2) a surcharge on medallion taxi fares; and 3) higher curbside parking fees within and north of the CBD.

Kheel Plan: Major Benefits

Our analysis of the impacts of the proposed Kheel Plan shows vast benefits for traffic flow, the economy, workforce, and quality of life for New Yorkers. The Kheel Plan will:

Reduce traffic within the Central Business District by 25% and within the entire city by 9%. Auto trips into the CBD will drop by nearly one-third.

Enhance mobility. The increase in transit trips into the Central Business District will more than offset the falloff in auto trips, resulting in a net 70,000 gain in daily "person-trips" into the CBD (a 2.4% rise). Citywide, half-a-million more trips a day will be taken in autos, subways and buses combined (a 2.8% rise).

"If you were to design the ultimate system, you would have mass transit be free and charge an enormous amount for cars."

— Mayor Michael Bloomberg, April 20, 2007

Save the public nearly $4 billion a year in recovered productivity, or more than 100 million "vehicle hours" now spent languishing in traffic. (Some 18% of this value will be realized by bus riders, 33% by truck, taxi and auto users within the CBD, and 49% by vehicle users in the rest of the city.)

More than recoup revenues now generated by fares. The one-two-three punch of the $16 automobile toll ($3 billion annually), taxi fare surcharge ($340 million annually) and higher curbside parking fees ($700 million annually), along with an estimated $170 million in savings from eliminating fare collection, will generate $4.2 billion annually — enough to replace the $3.5 billion in current tolls and transit farebox revenues and pay for both cordon fee administration and increased transit service while still leaving an annual revenue stream of almost $500 million to further improve transit.

Provide universal no-fare transit with less crowding than today's service. Making transit free will remove, once and for all, the threat of fare hikes, and be an enormous boon for New Yorkers, particularly low-income residents, for many of whom free transit will bring a $20-a-week after-tax raise. The Kheel Plan also includes a strategy for handling increased ridership that will result in less, not more subway crowding, with 4% fewer passengers per car, on average, during the 8-9 a.m. rush hour.

Shorten travel times. The Kheel Plan will enable a one-third (34%) increase in vehicle speeds within the CBD and an average one-tenth (10%) increase citywide. A typical 12-minute taxi trip in the heart of midtown Manhattan will be trimmed to nine minutes, while five minutes will be shaved from the typical 55-minute ride for a non-CBD trip, say from Bayside to Bensonhurst. Bus riders will save even more time: a fare-free system will eliminate the cumbersome swiping of MetroCards that leads to frustrating boarding delays, shortening a typical bus ride by more than four minutes.

Free up considerable road space. The reduced traffic in the CBD is equivalent to adding 230 new lane-miles of streets to the 920 actual lane-miles there. The Kheel Plan lets motor vehicles use half of the increase (thus enabling the improved vehicle speeds) but reserves

the other 115 lane-miles for public space improvements — bus and bicycle lanes, widened sidewalks, and public plazas. The new public space is equivalent in acreage to two dozen new Madison Square Parks or High Lines (the soon-to-open elevated linear park running from northwest Greenwich Village through Chelsea).

Produce additional, significant benefits. The plan will generate an additional $2 billion in health cost savings and other benefits from reduced pollution, fewer traffic crashes, lower insurance costs, and increased tendencies to walk and bike — all due to diminished traffic levels.

While a small portion of these benefits will be offset by the loss of amenity for drivers cutting back on car trips, city residents and businesses will still realize an overall net gain of $6 billion a year in time saved, improved health, increased agency revenue, and an enhanced natural and social environment.

Discussion of Analysis

During much of 2007, New York civic leaders were at loggerheads over the prospect of a transit fare hike and a complex congestion charging system proposed by Mayor Michael Bloomberg in April. This report addresses both issues, by offering an alternative and balanced solution to New York's transportation problems. It analyzes both the feasibility and benefits of a proposal, the Kheel Plan, to combine congestion fees and the elimination of fares on all New York subways and buses.

The study is issued at a momentous juncture in the evolution of managing congestion and funding transit. As this report goes to press, the Traffic Congestion Mitigation Commission is considering several alternative congestion pricing plans for New York. However, none of the plans being considered address the transit fare, which is set to rise in March for the tenth time in less than 20 years, with no long-term plan in sight for price stability. Moreover, no plan under consideration offers more than a modest reduction in traffic volumes or otherwise promises a game-changing restructuring of the city's love-hate relationship with the automobile.

> *"The dilemma confronting congestion pricing is not that opposition is too high, but that support is too low."*
>
> — UCLA Urban Planning Prof. Donald Shoup, *Access magazine,* Fall 2007

The Kheel Plan promises both, and more. It offers a new option that joins the two issues of congestion pricing and transit fares, creating a mutually reinforcing solution that greatly multiplies the public benefits of each and promises to balance car travel and mass transit efficiently and equitably. The consequent enhancement of almost every aspect of life will make mobility more affordable, universal and sustainable and establish ever more firmly the appeal and global competitiveness of New York City and the region.

Kheel Plan: Major Elements

The major elements of the Kheel Plan are as follows:

Transit

- Free subway and bus service throughout New York City
- Free express bus service throughout New York City
- Free intra-city commuter rail service throughout New York City

Motor Vehicles

- Autos pay $16 to enter Manhattan south of 60th Street (Central Business District, or CBD), including West Side Highway and FDR Drive
- Commercial vehicles pay double ($32), maximum of once per day
- Cordon fee replaces (does not add to) current (1-1-2008) tolls
- Cordon fee applies 24/7
- No toll to leave or drive within CBD; 19 charging locations
- Medallion taxicabs are exempt from cordon fee but fare rates rise 25% and incremental revenue is taxed (reduced waiting time limits average fare increase to 21%)
- Higher curbside parking charges throughout Manhattan south of 96th Street

The equity of a $16 entry charge is supported by the enormous benefit for drivers who pay the fee to enter the Central Business District: an average one-fourth reduction in travel time due to the reduced number of drivers on the roads. Moreover, the higher average income of regular auto commuters to Manhattan increases the value of their saved time and more easily enables them to internalize the costs that their auto travel imposes on others.

Drivers everywhere in the city will enjoy reduced travel times, averaging nearly 10% citywide, as well as a reduction in the unpredictability of their journey durations and arrival times. Everyone will benefit from reducing the pervasive effects of excessive auto use, including damage to environmental and individual health and the suffering caused by traffic crashes. Over time, lower traffic volumes will reduce taxpayer subsidies of driving, from policing and court costs to military defense of foreign oil, many of which were outside the balance sheet of this study.

To ensure that the $16 entry toll is not undercut by low-cost or free parking within and adjacent to the CBD, the Kheel Plan includes a parking pricing program encompassing three-quarters of spaces that are now unmetered. Fees for these spaces will be set high enough to achieve one available space on each side of a block, on average, sharply reducing or eliminating outright congestion-causing searches for parking. Extending this parking program to 96th Street will protect the Upper East and West Sides from parking by motorists

KHEEL PLAN vs. PLANYC

The Kheel Plan in effect combines Mayor Bloomberg's visionary congestion pricing proposal with his twice-recited plea that "free public transit is good public policy." By adding this essential transit counterpart, the Kheel Plan establishes a more sustainable and effective balance between the private auto and public transit. But while both plans recognize the economic importance of reducing congestion in the Manhattan Central Business District, the Kheel Plan also focuses on relieving the even larger burden of escalating traffic and transit needs in the surrounding boroughs where most trips originate.

Like the mayor's original PlaNYC proposal, the Kheel Plan deducts existing tolls from the new cordon fee, in order to prevent double-charging, to protect MTA and Port Authority revenues during a transition period, and to end the disparity of crossing costs that clogs approaches to free bridges. However, the Kheel Plan takes advantage of New York City's bridge and tunnel portals, requiring just 19 tolling locations in contrast to the 340 required under the mayor's proposal. (As this report was finalized, the mayor appeared to be moving toward replacing PlaNYC's inordinately costly monitoring network to track incoming, outgoing and internal trips.)

The PlaNYC proposal, while commendable and courageous, offers little if any relief to endlessly spiraling subway and bus fares; the Kheel Plan banishes fare escalation from the civic horizon by abolishing the fare itself. PlaNYC seeks to improve traffic speeds within the Central Business District by a modest 7.5%; the Kheel Plan, by incorporating free transit and imposing much higher tolls, will improve speeds by 34%, more than four times as much.

By packaging "carrot and stick" strategies, the Kheel Plan tackles traffic and transit more holistically and with greater detail. While both plans acknowledge the out-sized contribution of taxis to CBD congestion, only the Kheel Plan includes a surcharge on medallion taxi fares that can repay the public for taxis' share of congestion costs and, in combination with free transit, create incentives for the traveling public to choose alternatives when available.

To his credit, the mayor is exploring ways to address public pleas to reign in free on-street parking which entices many commuters to drive into the CBD and to park in transit-linked neighborhoods. The Kheel Plan does this, giving pricing of parking some of the stature it deserves as an essential backstop to road pricing, to reduce auto use by drivers both entering and living in Manhattan. Not coincidentally, pricing curbside parking at near-market rates provides a major new revenue stream, equal to between a quarter and a third of the revenue increment in the Kheel Plan from the cordon toll itself. This revenue will support not only free transit but the capital improvements needed to maintain and expand transit service.

who might otherwise seek to avoid crossing the 60th Street cordon, while providing an equitable equivalent of cordon fees for car-owning residents.

The Balanced Transportation Analyzer: Proving the Benefits of the Kheel Plan, and Providing An Interactive Research Model for Exploring Alternatives

Any major change to the fabric of a city's transportation system produces broad ripple effects in terms of behavior, traffic patterns and transit use. For the purposes of this analysis, we created a computerized spreadsheet model, the Balanced Transportation Analyzer (BTA), to test dozens of alternative capacity assumptions and the effects of price changes and time savings on travel choices. The model accounts for the inter-relation between traffic volumes and speeds, and it factors in the costs of operating the region's commuter rail, subway and bus systems at both current and higher levels of capacity.

All assumptions underlying the model have been set forth for public scrutiny. Moreover, the policy choices that we have made can be modified, and the interactive model will calculate the results. The BTA thus not only provides support for the Kheel Plan, it also offers policy-makers and citizens the option of testing different choices in "What if" scenarios. (To view the model, visit **www.nnyn.org/kheelplan**.)

The results of the BTA modeling show clearly that the Kheel Plan is the path to a more efficient, equitable and sustainable New York City. It achieves: 25% less auto traffic within the Manhattan CBD, and 9% less citywide; an overall increase in travel (and, presumably, economic activity), as growth in transit trips more than offsets the drop in auto trips; universal free transit with less crowding than today; huge gains in recovered productivity from saving over a hundred million "vehicle hours" that are now wasted in traffic each year; a big net gain in revenues, almost half a billion dollars a year, for the city's transit and transportation system; vast new public space in the heart of the city; and impressive environmental and health benefits stemming from the reduction in driving and increased walking and bicycling. (See more detailed description of benefits on pages 2-3.)

Exploring the Ramifications

A "cordon fee" has operated successfully in London since 2003. Stockholm followed suit in 2006, as did Milan in early 2008. Transportation planners almost unanimously agree that such "congestion pricing" is "the best way, and perhaps the only way, to significantly reduce urban traffic congestion," as UCLA Professor Donald Shoup put it recently.

Photo: Shutterstock

Yet no European city has coupled congestion pricing with free transit. And, as New Yorkers are fond of insisting, "We're different." Many questions have arisen in preliminary conversations with citizens and experts during preparation of this report about the ramifications of such a transformative plan. Some of those questions are addressed in the Questions & Answers section of this report. Here, we treat several issues in greater detail.

❶ Handling the Anticipated Increase in Ridership

Conventional wisdom suggests that congestion pricing matched with free transit would produce overcrowding on subways and buses, particularly on lines that are already quite busy. Yet our analysis shows that the system should be able to accommodate the increase quite easily.

There are several reasons for this seemingly counter-intuitive finding. First, discretionary off-peak transit travel is two to three times more price-sensitive than on-peak. This means that much of the increase in transit ridership — say, traveling uptown to a movie or down to Chinatown for dinner — will occur off-peak, when the existing system as currently operated generally has spare capacity. Some will occur in the "shoulder" hours of 7-8 a.m. and 9-10 a.m. as well. We estimate the added peak load on the subways during the critical 8-9 a.m. peak on an average weekday at a fairly modest 28,000 riders — only 7% of current

rush-hour volumes, and well under 10% of the 24-hour growth in subway trips into the Central Business District expected from the cordon fee and free transit.

Second, fortuitously, the most crowded subway lines originate in corridors served by commuter rail lines that could be operated to attract in-city riders, thereby freeing up capacity for subway riders closer to the core. The commuter railroads serving the Manhattan core from the north and east — Metro-North and the L.I.R.R. — have considerable unused seats during the morning peak. Moreover, both lines have the track capacity to operate additional trains, using rolling stock that is available today or could be made available within 18 months. The same is true for NYC Transit buses that enter the CBD from northern Manhattan, Brooklyn and Queens.

We estimate that 27,000 peak-hour subway riders could relocate to parallel commuter rail and bus lines, **and will likely do so**, once in-city rail trips are discounted in tandem with subway trips and bus speeds improve due to rapid (fare-free) boarding and less competing traffic. An additional 5,000 current peak-hour subway riders living close to the CBD are expected to switch to bicycle commuting, freeing up even more space for the new straphangers lured (or tolled) out of automobiles.

Much of the increase in subway ridership will occur off-peak, when the existing system has spare capacity.

On balance, then, the 32,000 peak-hour subway riders whom we estimate will shift to other modes will slightly more than offset the 28,000 new riders generated by the cordon fee and free fare. In addition, we have found that even during the 8-9 a.m. peak hour, most subway lines could add trains within the feasible operating track capacities of each route. (These lines currently operate below capacity primarily for reasons of economy.)

We have calculated that NYC Transit could add some 211 cars to the 3,700 cars currently scheduled to arrive in the Central Business District during the 8-9 a.m. peak. This would ensure that virtually every train exceeds the agency's passenger-space criterion by a comfortable margin, on an average weekday. Fielding this many subway cars would require approximately 380 cars (to allow for logistics, maintenance, etc.), of which half could be provided by retaining and reconditioning cars now slated for scrappage, while the other half would have to be purchased. The costs to deploy these cars — an estimated $500 million in capital costs and $90 million in annualized costs including amortization — are included in our budget and cost-benefit analysis.

Combining all these factors, we find that the Kheel Plan will not only handily manage the ridership shifts from auto and taxi to transit, but that it will do so with an average 4% more space per passenger than today's levels.

❷ Impact on Business Revenue

Any congestion pricing proposal must consider the impact of vehicle fees on overall travel and commerce. Ensuring that business activity doesn't suffer was an important part of our rationale for coupling the cordon fee with free transit.

We estimate that the combined cordon fee and free transit in the Kheel Plan will eliminate a quarter of a million auto trips into the CBD each weekday, representing approximately 340,000 "person-trips" (accounting for multiple-passenger autos). In their place will be 360,000 new transit trips into the CBD (nearly 95% via subway and the rest via transit bus), along with an additional 50,000 person-trips in cars, due to a modest but noticeable 6-7% increase in vehicle occupancy rates resulting from the cordon fee (equivalent to adding one passenger in every twelfth car or cab).

The Kheel Plan, then, results in a net 70,000 gain (2.4%) in the number of people traveling into the Manhattan core on an average weekday. The anticipated gain in travel **outside** the CBD is many times greater, an estimated 410,000 net new trips attracted out of cars and into free subways and free (and faster) buses. New York City will be even livelier than today — as well as safer and more sustainable.

❸ Impacts on MTA Workers and Taxi Drivers

We also examined the Kheel Plan's prospective impacts on MTA workers and on the taxi industry. We envision no decrease in the MTA workforce. Fare collectors will be retrained to staff the new trains necessary to handle increased ridership, and technicians who maintain the automatic fare collection machinery will be engaged in maintenance of the expanded transit fleet.

The number of taxi rides per shift will increase by 15-20%, thanks to reduced traffic gridlock, while the number of taxis in service diminishes.

We have assumed fairly modest savings — slightly under half of current fare-collection costs — from transitioning to free transit, largely in fare administration. Much of that savings was then re-inputted into our estimates of the cost to operate and maintain the increased number of subway cars and trains.

On the taxi front, our estimates suggest that while the number of rides in medallion taxis will decline slightly (by about 3%), the average number of rides per shift will increase by 15-20%, thanks to reduced traffic gridlock, particularly within the CBD. This striking increase in productivity should translate to increased earnings for both driver and owner, although the number of taxis in service will diminish.

Although we didn't include it in our cost figures, we believe that the reduction in motor traffic — an estimated 9% citywide; 25% within the CBD — could allow sufficient police

resources to be transferred from traffic management and crash adjudication to subway policing to ensure that free transit is kept safe and reasonably convivial.

❹ Impact on Safety and Quality of Life

Positive changes in the city's streetscape will be pronounced under the Kheel Plan. The dramatic reduction in motor vehicle travel within the CBD will provide the spatial wherewithal for a raft of improvements such as sidewalk widenings, bicycle lanes, and Bus Rapid Transit lanes that have heretofore been held hostage to the imperatives of auto traffic.

Consider that if all the lanes (including "parking lanes") on all the streets and avenues in Manhattan's Central Business District were laid end to end, they would extend for an estimated 920 miles, or "lane-miles." With motor traffic within the CBD anticipated to decline by 25% under the Kheel Plan, the same level of traffic congestion as today could be maintained by taking 25% of the street space, 230 lane-miles, out of service. We propose splitting this dividend equally: letting cars and trucks use half (which is how we derive the improved vehicle speeds projected for the CBD) while the other half, the equivalent in space of 115 lane-miles, is dedicated to the bus, bike and pedestrian lanes (sidewalks) just mentioned, along with public space such as plazas.

This newly minted public space amounts to 160 acres, the spatial equivalent of two dozen new Madison Square Parks.

This newly minted space amounts to 160 acres, the spatial equivalent of two dozen new Madison Square Parks (6.2 acres) or High Lines (this is the linear park currently being fashioned from a defunct elevated railway from 34th Street to Gansevoort Street, covering 6.7 acres). These comparisons, which are illustrative only, are meant to convey the extraordinary bounty that will be created in the heart of Manhattan from the traffic reductions under the Kheel Plan.

Photo: Shutterstock

Of course, the reduction in vehicle traffic outside the CBD, estimated at 9%, will also expand opportunities for walking and bicycle-riding in neighborhoods across the city, thus contributing to increased physical activity and enhanced health for New Yorkers. Indeed, the increased longevity for city residents who will take advantage of diminished traffic to walk and bike-ride for transportation and pleasure is, by our calculations, a societal benefit worth a billion dollars a year — ample evidence of the Kheel Plan's capacity to transform our city for the better.

Conclusion

We are at a tipping point in the city's traffic crisis and the need to reduce petroleum use and carbon pollution. A bold policy with free mass transit at its center will take thoughtful planning and start-up costs to implement. But these challenges are not insurmountable, and New York City can lead the way. By charging a steep but fair price to drive into the city's

dynamic but congested nerve center, the Kheel Plan can liberate New Yorkers from the twin tyrannies of endless fare spirals and never-ending traffic jams.

The Kheel Plan promises not just to reform our transportation system but to transform our city. It will replace the car-centric clog to which we have resigned ourselves with a better-functioning and more harmonious balance of automobiles, public transit, walking and biking.

As a society, we have chosen to make schools, police, and fire protection free because they are "public goods" whose universal use benefits everyone. That's equally true of transit, and it's time we managed it that way. Free transit will bring enormous benefits to all New Yorkers. This report points the way to making it possible.

TABLE 1: Kheel Plan, Key Impacts

Reduction in auto trips entering CBD on typical weekday	**253,900**
Above figure, as % reduction in auto trips now entering CBD	**31.7%**
Net increase in persons entering CBD by transit or auto on typical weekday	**68,500**
Above figure, as % increase	**2.4%**
% increase in citywide person-trips by transit or auto	**2.8%**
% reduction in VMT within CBD (all motor vehicles, not just autos)	**25.4%**
% reduction in citywide VMT (all motor vehicles, not just autos)	**8.9%**
% improvement in traffic speeds within CBD	**34.1%**
% improvement in traffic speeds outside CBD	**10.2%**
% reduction in citywide CO2 emissions from all motor vehicles	**10.1%**
Net increase in annual agency revenues (tolls plus farebox revenues)	**$460,000,000**
Additional net annual economic, social and environmental benefits	**$5,500,000,000**
of which time savings by motor vehicle users (including bus riders) are	**$3,870,000,000**

CBD = Manhattan Central Business District. VMT = Motor vehicle-miles traveled.

QUESTIONS AND ANSWERS ABOUT THE KHEEL PLAN

Q: Rush-hour subway lines are hellishly crowded now. What will happen when the Kheel Plan shifts thousands more New Yorkers from cars and onto trains?

A: Most travel during peak hours is non-discretionary work trips, so the free fare alone is not expected to add many riders beyond those who will switch from driving due to the cordon fee. According to our analysis, the increase in rush-hour (8-9 a.m.) subway ridership due to the combined cordon fee and free subways will actually be slightly less than the number of current straphangers who will switch to parallel bus and commuter rail lines and bike lanes. This switch will not be forced but attracted by (i) faster bus travel due to fare-free boarding and lower traffic; (ii) provision of free in-city rail service; and (iii) safer and less stressful cycling due to shrunken traffic and increased street space. Nevertheless, the Kheel Plan provides half-a-billion dollars of capital to retain and deploy nearly 400 additional subway cars and associated equipment to expand subway service to levels permitted by available track capacity. This will reduce subway crowding (as measured by rush-hour passengers per car) by an estimated 4% — not quite the millennium, but a step in the right direction.

Q: Will your cordon fee have to increase over time beyond the proposed $16, which many already regard as draconian?

A: The base cordon fee would have to rise if there were an inflation-generated erosion of its deterrent effect or if further analysis or experience demonstrated that time-of-day variable tolls were more effective and generated more revenue for transit. Other funding sources to cover rising transit costs could be tapped in that event. For example, fleets that disproportionately contribute to congestion but may not be fully captured by the cordon fee, such as overnight mail services and "black cars," could be added to the revenue pool by using their current GPS technology to charge per distance or time driven. The explosion of interest region-wide (and nationally) in congestion pricing suggests that, eventually, all major traffic streams will have user fees. But until that time, the Kheel Plan offers New York City a practical way to balance transit and the automobile in service of the greater good: improved access to the CBD, more affordable transportation, and recovery of staggering amounts of time now lost to traffic.

Q: PlaNYC projects that, over the next 30 years, New York City will have to accommodate another million people and 750,000 new jobs, much of this in Manhattan. How does the Kheel Plan address this issue?

A: The unspoken question is, how will the city accommodate this growth *without* the Kheel Plan? Only the combination of an appropriately steep congestion fee and free transit can leverage the financing and incentives necessary to provide mobility at the scale required for a functioning, growing New York. Moreover, as noted in the preceding answer, the Kheel Plan can and should be adapted over time to internalize congestion costs for all city driving, not just into the CBD but within and outside it.

Q: Might a $16 cordon fee kill off economic activity within the CBD, to the detriment of the entire city?

A: Quite the opposite. Our calculations show a net increase of nearly 70,000 person-trips a day into the CBD. Mathematically, this is because the expected reduction in CBD-bound person-trips made in cars or cabs, almost 340,000, is more than offset by the expected increase in trips made by subway, bus or carpooling, 410,000. (That figure doesn't include increased trips on commuter rail or bicycle, making our increase a conservative estimate.) The net change equates to a 2.4% increase — not a large figure, but one with the right sign. The estimated net increase in trips outside the CBD is 2.9%, resulting in a 2.8% increase citywide.

Q: How does the Kheel Plan benefit the boroughs?

A: The provision of free citywide express bus service and free (and expanded) intra-city commuter rail service will be a boon to residents of Queens, Brooklyn and the Bronx. And regardless of whether or how often they drive into Manhattan, motorists in the boroughs will benefit from faster travel on all roads. Nearly half (49%) of the projected time savings for drivers will be experienced outside the CBD (i.e., in the four boroughs plus northern Manhattan), while another 18% will be captured by bus passengers, again, largely on routes outside the center of the city. This is due to the provision of free transit, which will disproportionately increase bus travel (due to the speed-up in boarding and driving); and also to the fact that most trips into the CBD have a substantial upstream component outside the center.

The reduction in overall traffic levels and especially on feeder roads to now-free bridges will greatly reduce the burdens of traffic on neighborhood streets and provide the road capacity needed to accommodate planned development. A full accounting of the hidden costs that vehicle travel imposes would almost certainly find that the boroughs will receive far greater value from reduced traffic than the tolls their residents will pay — particularly considering the portion of the tolls to be paid by suburban drivers.

Q: Your spreadsheet model analyzes only one option for a time-of-day cordon fee, and even that only partially. Are you working on improvements?

A: Yes. Although our BTA (Balanced Transportation Analyzer) spreadsheet model represents a big step forward in modeling travel in New York City, we recognize the value of further development. Our intended next big steps are to (i) tie time-of-day cordon pricing into the traffic analysis (it now only calculates the revenue change); (ii) allow the user to choose the hours and price levels for the variable cordon fee; and (iii) permit analysis of peak-period subway pricing. We also hope to calibrate the BTA with the more detailed but opaque "Best Practices Model" used by regional transportation planners. (See sidebar, p. 19.)

Q: Won't drivers rush to take advantage of the more freely flowing roads, thus negating the intent of the cordon fee to cut traffic?

A: Yes, they will, which is why we built into the BTA the capability to model the effect on travel not just of price but also of time. This "bounceback" effect (also called "induced

travel") is significant — offsetting around 20% of the initial price impacts of the $16 cordon fee and free transit — but not enough to cancel them altogether. Interestingly, opponents of congestion pricing often overlook bounceback in urging alternative approaches such as traffic enforcement or highway expansion that are vulnerable to induced travel precisely because they lack congestion pricing's market-clearing aspect.

Q: Your traffic-demand and choice modeling rests on 30-year-old estimates of price-elasticity and time-elasticity for driving and transit use. Isn't that too long a stretch?

A: No, for three reasons. First, elasticities are proportional, not absolute, and there's no reason to believe that the relative importance of time and money in travel decisions has changed greatly. Second, when we independently measured one of the key parameters,

ALTERNATIVE FEES AND FARES

The Balanced Transportation Analyzer spreadsheet makes testing other pricing scenarios a snap. Here are a handful that produce the same projected gain in net annual revenue as (i.e., within $20 million of) the Kheel Plan's projected $460 million increase.

Table 2 shows, not surprisingly, that only charging a higher cordon fee (Scenario 5) can top the Kheel Plan's traffic reductions. Scenario 4 shows the importance of making buses free, apart from whether the same is done for subways. This is because eliminating the fare is key to more rapid bus operation which will attract passengers from cars.

Table 2 also suggests one or more interim strategies to bridge the gap from the current system to the ultimate fare-free plan. A $10 round-the-clock cordon fee would provide sufficient revenue (in conjunction with the taxi surcharge and parking fees included in the Kheel Plan) to finance free buses and an almost 60% price break for subways. Though the drop in traffic would be only around two-thirds as great as under the Kheel Plan, this could nevertheless be an attractive transition plan, particularly if the subway fare were stratified by time of day (free off-peak but undiscounted on-peak, perhaps) — an option we are committed to exploring in the near future.

TABLE 2: Alternative Pricing Scenarios (yielding same net revenue as Kheel Plan)

	CORDON FEE	24/7?	FARE DISCOUNT SUBWAY / BUS	AUTOS TO CBD	CITY-WIDE VMT	COMMENT
1	$16.00	Yes	100% / 100%	–32%	–8.9%	Kheel Plan.
2	$16.00	No	80% / 100%	–28%	–8.2%	Off-peak cordon discount comes at a price.
3	$13.00	Yes	80% / 100%	–25%	–7.3%	Dropping fee $3 cuts into traffic reductions.
4	$12.00	Yes	75% / 75%	–24%	–6.6%	Even 25% fare reduces bus attraction.
5	$19.50	No	100% / 100%	–35%	–9.7%	Off-peak price break requires higher base.
6	$10.00	No	58% / 100%	–20%	–5.9%	Possible interim plan?
7	$12.00	Yes	73% / 100%	–24%	–6.9%	Another viable alternative?

CBD = Manhattan Central Business District. VMT = Vehicle Miles Traveled. Scenarios shown are small subset of the full range of conceivable ones. These include time-of-day cordon fees contoured differently from the single shape offered in the current BTA model, and peak pricing of subway service into the CBD. Note also that percentages shown for auto trips and VMT do not reflect impact of off-peak discounts on travel times or levels — a glaring limitation which will be cleared up in next iteration of BTA.

drivers' price-elasticity, using 1978-2005 data, it perfectly matched the result from the 1977 study. Third, our key findings — that a steep cordon toll can finance free transit and that the two measures combined can slash driving into the CBD — are "robust" across a wide range of elasticities (readers may confirm this by changing the values in the Tri-State Elasticities worksheet of the BTA).

Q: Won't a $16 cordon toll choke off the very traffic flow needed to ensure a hearty revenue stream to finance free transit?

A: This would be a concern only if driving into the CBD were extremely sensitive to price, i.e., if its price-elasticity were greater than one. At our estimated elasticity value of 0.7 (actually, 0.5 for work trips and 0.9 for non-work trips), raising the cordon fee will always generate added revenue since percentage-wise the drop in traffic will always be less than the rise in the price to drive into the cordon zone. As evidence of this, many drivers who currently pay much more than $16 to park off-street are not likely to be deterred by the cordon charge.

Q: How will the Kheel Plan handle the influx of CBD-bound drivers who will seek to park just outside the zone?

A: The plan essentially does away with free curbside parking in Manhattan north to 96th Street. Charging $4 an hour to park between 60th and 96th Streets during 7 a.m. and 6 p.m., as we propose, will remove most of the incentive to park there and hop on a bus or train into the CBD.

Q: With the subways free, how will you combat vandalism such as occurred on the Staten Island Rapid Transit System when fares were eliminated there? More generally, wouldn't no-fare subways become the province of criminals whom fares currently deter?

A: Subway platforms and trains will need additional policing. We anticipate that the 9% reduction in traffic citywide (25% within the CBD) effected by the Kheel Plan will free up considerable police personnel now dedicated to managing traffic flow and adjudicating crashes and injuries. It would be appropriate to allocate some of these resources to subway policing, particularly during a transition period.

Q: By some accounts, many New Yorkers don't mind paying for transit so long as they believe they are getting fair value in return. Why zero out their contribution to revenues?

A: Because the century-old paradigm of farebox financing of transit, and its more recent variant, an intricate but fragile filigree of taxes and subsidies, is exhausted. And because we are proposing a new paradigm of accessibility in which transport reverts to its role as a means to an objective (job, shopping, theatre, doctor, etc.), not an end in itself. Barrier-free transit promises a new sense of mobility that will make the whole city a resource for everyone to enjoy. If the public is reticent about going the whole way right away, intermediate steps might be to charge a somewhat lower toll and maintain peak period subway fares while offering free local bus trips (which are already heavily subsidized) and free off-peak

subway service which is more responsive to price and for which there is ample capacity. This assumes, however, fare parity among subways, express buses and in-city commuter trains to achieve the Kheel Plan's anticipated shift of passengers among modes that provides the necessary capacity for added transit riders.

Q: How did you model the effects of a $16 toll and free NYC transit on New Jersey commuters?

A: Time limitations precluded us from separately analyzing travel demand into the CBD by "portal" — Queens, Brooklyn, Manhattan north of 60th Street, and New Jersey. For example, in estimating the extent to which the cordon fee would raise the price to drive and thus attenuate demand, we applied an average toll rate that we calculated for drivers from all four regions. Disaggregating by geographical region is another improvement we hope to make in the BTA spreadsheet model.

Q: The MTA currently uses transit fares to pay interest on bonds issued to finance capital expansion. How will the interest be paid with free-fare transit?

A: Outstanding fare-backed debt would have to be converted to or replaced by new debt backed by cordon fee revenues. Neither the legal mechanics nor political bargaining necessary to implement the Kheel Plan seems particularly daunting, particularly when compared to previous feats of financial legerdemain such as New York State's creation of its Municipal Assistance Corp. in the 1970s.

Q: If, as you say, transit, like schools, police, and fire protection, is a "public good" whose universal use benefits everyone, and thus should be free, why shouldn't driving on streets and roads be free as well?

A: Because driving, particularly into the Manhattan Central Business District, uses up road capacity, thus making it less available to others. That is the "negative externality" at the heart of the automobile paradox: that car use benefits the driver but costs everyone else — including other drivers (except on underutilized roads). A motorist entering a crowded roadway, the Queensboro Bridge, say, causes delays not only to himself, but to a thousand motorists behind him; yet he pays only for his own lost time, leading him to drive even when the total delay-cost to society of his trip outweighs the gain to him.

Congestion pricing, and only congestion pricing, resolves the paradox by internalizing society's delay-costs within each individual's price to drive. This explains why, to paraphrase Amy Traub of the Drum Major Institute, the "right" to drive a private car cheaply into the CBD cannot be considered a public good.

Q: Will a plan that makes transit free require time to realize?

A: Certainly. But that's not an argument for delay, it's an argument for starting right away.

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TRAFFIC ANALYSIS

Introduction

This traffic analysis is concerned primarily with the Manhattan Central Business District (CBD), since it is that domain which cars and trucks will be charged a fee to enter. However, the effects of the entry fee will ripple outside the Manhattan core: since all trips into the CBD originate outside (by definition), a decline in such trips necessarily means less traffic in other parts of the city as well. Even more importantly, the advent of free transit citywide will affect travel patterns throughout the five boroughs by converting some car trips to transit and by attracting brand-new trips. The traffic analysis therefore encompasses all of New York City, although it focuses on the Manhattan CBD.

The simultaneous introduction of free transit and a cordon fee will greatly alter the quantity and nature of trips into the Manhattan CBD. "Carrot and stick" is the governing metaphor, with free transit as the carrot and the cordon-entry fee as the stick. Our analysis estimated their separate effects and then combined them, applying a mathematical adjustment to ensure we didn't double-count auto trips that might be lured into free transit and also "tolled off the roads."

The stick: a cordon entry fee

We analyzed a $16.00 cordon entry fee for automobiles driven into the CBD. (The "Balanced Transportation Analyzer," our spreadsheet model, allows this variable to assume any amount.) Currently, autos driven into the CBD pay a round-trip toll averaging a little under $3.00 (this is a weighted average of trips entering the cordon via the various portals, including the free East River bridges); hence, replacing the current hodgepodge toll regime with a $16.00 flat fee represents more than a five-fold toll increase. However, the total out-of-pocket cost of a round-trip into (and out of) the CBD includes other elements besides tolls — gasoline, parking (where applicable), wear-and-tear, and even, depending on the driver, a perception that the trip might bring a costly traffic ticket or even a car crash. By our estimates, these other costs today average $17.00 for a typical trip into the CBD, bringing the total average cost of such trips, with tolls, to $20.00. Since these other costs remain more or less the same, *the average $13.00 rise in tolls will raise the average price of a CBD-bound auto trip by around two-thirds (66%), from $20.00 to $33.00*.

We thus pose the question: what effect will an average $13.00 (66%) increase in price have on the number of auto trips into the CBD? Here, it may help to think in terms of the trip's "net benefit" to the trip-taker: if the driver currently perceives the trip as having a net value (after considering the various benefits and costs to her) greater than $13.00, then a $13.00 increase in the trip's price shouldn't dissuade her from making the trip, since the trip will still have a positive net value even with the higher toll. Conversely, where the trip's worth to the trip-taker is now less than $13.00, a $13.00 hike in its price should tip the trip into "negative benefit land," leading to its cancellation.

The advent of free transit citywide will affect travel patterns throughout the five boroughs.

To be sure, few if any of us think in these terms, at least not explicitly. Even if we did, it would be impractical if not impossible to poll auto users to count the trips they would abandon due to the cordon fee. A different approach is needed to estimate the effect of the fee on the number of auto trips into the CBD. Fortunately, one is readily available, under the rubric of "price-elasticity."

In plain English, price-elasticity refers to the extent to which demand for a product or service changes as a result of changes in price. A product is considered price-elastic if price swings evoke wider swings in demand — and inelastic if they don't. *Mathematically, price-elasticity is the percentage change in demand or usage associated with a one percent change in the price*.

How elastic (or inelastic) are auto trips into the CBD? There are two known investigations of this subject. One was undertaken by the Tri-State Regional Planning Commission (TSRPC), the now-defunct regional transportation planning agency, in 1977. The other was done in 2007 for this study. Happily, their results agree.

The TSRPC study ("Short Term Effects of Transportation Policy Changes on Auto and Transit Ridership," Interim Technical Report 5303, August 1977) is more of a "meta-study" in that it reviewed the relevant literature and did not conduct original empirical research. It approximated a price-elasticity for "work trips" (commutes) into the CBD of 0.5, and 0.9 for non-work trips. The lower figure for commute trips indicates that they are less price-sensitive than non-work trips, a finding that accords with the notion that non-work trips are more discretionary and, hence, more susceptible to factors such as price changes.

The other study, our own, is documented in the Balanced Transportation Analyzer, or BTA (in the worksheet tab, **Regressions**). There, we applied standard statistical "linear regression" techniques to 1978-2005 travel data to infer the price-elasticity of motor vehicle trips across the East River. We "regressed" (correlated) the annual volume of trips on all East River crossings (both tolled and untolled) against that year's average round-trip cost, which in turn was estimated as the weighted average of gasoline, parking and tolls. To avoid confounding the analysis with variations in economic activity, we controlled for the number of Manhattan jobs in each year. (We also "smoothed" the data by using two-year running averages, along with a single five-year average for 2001-2005 to level out 9/11 impacts.) The result was an estimated price-elasticity of 0.7, *which happens to equal the mean of the TSRPC's estimated elasticities for work and non-work trips to the CBD*.

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Non-work trips are more discretionary and, hence, more susceptible to price changes.

Having been confirmed by our independent analysis, the TSRPC estimates are deemed suitable for projecting the impacts of the cordon fee on auto trips into the CBD. As noted above, in percentage terms, the advent of a $16.00 cordon entry fee will result in an average 66% increase in the total out-of-pocket cost of the trip. Mathematically, the change in the number of work trips into the CBD should be predictable by the expression, **1.66 raised to the negative 0.5 power**, while the change in non-work trips into the CBD should be given by **1.66 raised to the negative 0.9 power**. (These exponential formulations arise from the mathematical definition of elasticity, and are consistent with the statistical processes by which the elasticities were estimated in the first place.)

The first bolded expression yields 0.78 (or 78%), which denotes a 22% reduction in the number of work-bound auto trips from increasing the trip price by 66% ($13.00) over the base price. The second underlined expression yields 0.63 (or 63%), denoting a 37% reduction in non-work trips due to the $16.00 cordon fee.

This is not the end of the story, however. With fewer autos driving into the Manhattan core, highways and streets leading into and out of the CBD will be less crowded and, thus, more free-flowing. Since travel **time** as well as **price** influences people's travel choices, the advent of a faster ride due to the cordon fee should, ironically, cause some offsetting *increase* in the number of trips.

This phenomenon is well-known to transportation experts and indeed to anyone who thinks analytically about traffic flow and its determinants. It is sometimes referred to as "trip attraction" or "the rebound effect"; we call it "bounceback." (If the notion of bounceback isn't clear, it may help to think of the thinner traffic stream as the functional equivalent of adding new highway or street lanes,

THE BALANCED TRANSPORTATION ANALYZER

The analysis in this report was performed using a specially designed computer model. This model ties together every facet of passenger transport in New York City, including transit, auto, taxi and bike; incorporates the effects of price changes and time savings on individuals' travel choices and aggregate travel demand; takes account of the interactivity between traffic volumes and speeds; and factors in the costs to upgrade the region's commuter rail, subway and bus systems.

We call our model the Balanced Transportation Analyzer, or BTA — "balanced" because it manifests the equilibria within and between the different travel modes, and "analyzer" because interested parties may use it to examine the assumptions underlying our findings and also test the effects of other assumptions and policy choices.

The BTA differs from the official computer model that has been designed to simulate travel patterns in the New York metropolitan area. The New York Metropolitan Transportation Council's "Best Practices Model" (BPM) was developed over many years at a cost of more than $30 million. Because of its size and complexity, the BPM requires hundreds if not thousands of hours to set up and debug, and each model run takes high-powered computers a week or more to complete, limiting its accessibility to a few selected consulting firms. Even the officials who authorize its use cannot see into the "black box" to confirm the underlying assumptions, equations and algorithms.

The BTA provides a powerful and nuanced sketch-planning tool to test what-if scenarios that can be used in conjunction with the BPM. Our confidence in the consistency of the two models grows from a test of the PlaNYC congestion proposal with the BTA which yielded similar results to those reported to have been generated by the BPM.

The authors and publisher invite you, the public, to download the BTA (see link below) and launch it using your customary spreadsheet program. While it may appear daunting at first glance — it consists of close to three dozen worksheets, intricately interlinked — you may find the BTA delightfully simple to follow.

The first five worksheets — Introduction, Summary, Revenue, Cost-Benefit and Travel — contain the model's key findings. The BTA's analytical core, particularly the interactivities between cars and transit and among price, time and demand, resides in the next three, Traffic, Transit and Transit Capacity. The remaining two dozen worksheets, Bicycles, Buses, Transit Costs and the like, primarily develop and feed input assumptions to the earlier worksheets.

Go to Summary to design your own pricing plan. There you'll find 10 "policy choices" — cordon fee amount, how far transit fares are to be dialed down, a "subway space index" and so forth — and a dozen key results, ranging from traffic reduction percentages to the net amount of new funds available for mass transit. If you feel your plan trumps ours, let us know.

We plan to continue adding features to the BTA, including the capacity to analyze peak-hour subway pricing and to let users design their own time-varying cordon-pricing schedules.

To download the BTA, click on www.nnyn.org/kheelplan.

which would obviously tend to induce additional driving by making car travel more time-efficient.) And yes, there is a way to account for it in the event of a cordon fee (or free transit), which we have applied here.

Our process for estimating bounceback rests on the "time-elasticity" for auto travel into the CBD as estimated in the same 1977 TSRPC study noted above: 1.00 for work trips and 1.24 for non-work trips. Translated, these values mean that, for work trips, each 1% lengthening (or, conversely, shortening) in trip duration should translate into a 1% decrease (or increase) in the number of auto work trips; for non-work trips, the changes in trip levels would be somewhat greater (with the percent changes in trip volumes estimated to be 1.24 times as great as the percent change in travel time).

To apply these estimated time-elasticities to our scenario of a cordon fee, we had to segment a typical auto trip into the CBD into two sections — the typically longer part *outside* the CBD, for which the

DRIVER IMPACTS

Drivers will pony up some $3 billion a year under the Kheel Plan — $2.4 billion more than they now pay in cordon tolls, plus $500 to $700 million in higher parking fees. What can they expect in return?

Superior transportation and a more economically competitive city. More and better bus, subway, rail and biking options for everyone. And, of course, faster, smoother, shorter car trips for those who continue to drive. Cars, taxis and trucks combined will spend 104 million fewer hours in traffic in New York City — not due to fewer trips (we exclude that decrease in tallying saved hours) but because diminished traffic levels will quicken car travel. Over time, this will stem the travel-time surcharge now built into the cost of goods and services in New York City.

By our calculations, these time savings translate to $3.2 billion in increased productivity. That figure draws on estimated values of drivers' time ranging from a low of around $7 an hour for off-peak single-occupant vehicles that were estimated to constitute 25% of the traffic stream, to $140 an hour for the 2% of traffic made up of "big rig" 18-wheelers. (The weighted-average value of all saved time is a little over $30 per hour — more for time saved in the CBD, which accounts for a quarter of the total, less for the remaining three-quarters of hours saved in the rest of the city.)

While motorists' time savings will roughly offset their tolls and parking fees, drivers who choose not to pay the congestion fee will face the undeniable loss in "amenity" — the recognized advantages of driving — a seated ride door-door, choice of departure time (if no assurance of arrival time) and privacy. The loss of these amenities for an estimated 700,000 fewer trips on an average weekday, or 230 million annually, equates to almost $600 million a year (see Cost-Benefit Analysis for derivation).

Offsetting this cost, somewhat, to those driving less into the CBD, will be $70 million savings in car insurance and much of the estimated $420 million in reduced crash costs resulting from the decline in driving. Ultimately, for households able to forego a second car (or the first), there will be savings, not accounted for here, of the substantial costs associated with auto ownership. For motorists, fewer other drivers jockeying for road space will mean less traffic chaos, calmer travel and more predictable journey times. This will save drivers' having to allow extra travel time to avoid the penalties of being late for day-care pick-ups, doctors' appointments, curtain-raisings and critical business engagements. Putting a dollar value on this benefit was beyond the scope of this study, but drivers know the value is real.

If drivers' pluses and minuses roughly balance in the aggregate under the Kheel Plan, that is no guarantee that they will do so for all individuals. Some drivers will be made better off while others will fare worse. What is indisputable is that New Yorkers, overall, a composite of non-drivers and occasional car users as well as habitual drivers, will be far better off with the reduction in traffic and the availability of free transit.

driver would experience a modest reduction in trip time (since fewer autos are now being driven); and the shorter section within the CBD, in which the speed-up in traffic and time saving would be more pronounced. A key parameter or variable was the extent to which the reduction in traffic *within* the CBD — which may be thought of as a gain in the number of driving lanes — would be "given away" to drivers (thus resulting in big speed gains); or, as an alternative, would be reserved for non-auto uses such as wider sidewalks or bike or bus lanes, which would attenuate the improvement in speeds (and the resultant re-attraction of motor vehicles).

For this study, we chose to sequester half (50%) of the increase in effective road capacity. *This assumption effectively halves the gain in CBD speeds that would be expected if we allowed drivers to take advantage of all of the thinning of the traffic stream.* (The BTA allows this percentage to be varied between zero and 100%.) Nevertheless, the calculated gain in average travel speeds in the CBD due to the combined cordon fee and free transit is a still-impressive 18%. For trip segments outside the CBD, the calculated speed gain ranges from 6% to 8%, depending upon whether the trips are work or non-work. When the CBD and non-CBD segments are combined, and the overall

speed improvements from the thinned-out traffic stream are inputted to the time-elasticity formula, the result is a calculated speed-caused increase in auto trips into the CBD of 9% for work trips, and 10% for the more time-sensitive non-work trips.

These calculated increases in vehicle speeds offset a goodly fraction — around a third, in rough terms — of the initial dropoff in auto trips into the CBD due to the cordon fee, noted above. *This effect is significant enough to warrant a second round of "bounceback" calculations*; of course, this round works in the direction of *fewer* trips because the first round of bounceback has restored some of the lost traffic, thus making the roads slower, which discourages some trips.

In theory, this back-and-forth process continues indefinitely. In practice, the swings of the pendulum drop off to minimal levels around the seventh iteration (in this case), which is how far we carried the calculations in the BTA. At that point, *the $16.00 cordon fee is projected to eliminate roughly one-sixth (17%) of auto work trips into the CBD, and one-third (33%) of non-work trips*. These results are summarized in Table 3.

TABLE 3: Some Results of Traffic-Equilibrium Analysis for $16.00 Cordon Fee
Note: These results do not include free transit, and are illustrative only.

	WORK TRIPS	NON-WORK TRIPS
Average Increase in Price	**66%**	**66%**
Price-elasticity of Auto Trips to the CBD	**–0.5**	**–0.9**
Calculated Reduction in Auto Trips	**22%**	**37%**
Improvement in Travel Speed (first iteration)	**9.3%**	**7.7%**
Time-elasticity of Auto Trips to the CBD	**–1.00**	**–1.24**
Increase in Auto Trips (first bounceback iteration)	**9%**	**10%**
Net Reduction in Auto Trips (after seven iterations)	**17%**	**33%**
Share of Initial Reduction Re-attracted by Bounceback	**22%**	**11%**
Improvement in Travel Speed (after final iteration)	**7.3%**	**6.9%**

The carrot: free transit

We also analyzed the impacts on travel demand of making transit free throughout New York City. To an extent, this analysis paralleled that just described for the cordon fee. We first estimated the number and types of present auto trips that would be "lured out of cars" by eliminating subway and bus fare collections. We then calculated the speed-up in traffic flow inside and en route to the CBD and used the results to estimate the traffic "rebound effect" (or "bounceback") as a result of the increased time-efficiency of driving, repeating the process through a half-dozen iterations until reaching equilibrium.

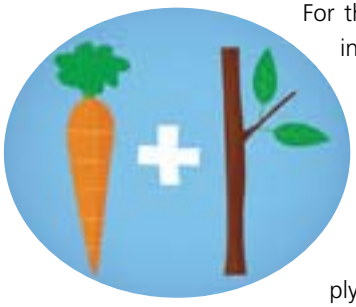
However, this analysis differed from the cordon analysis in important respects. First, the relevant price-elasticity is not that of auto trips but of transit trips. Second, in applying the time-elasticity of transit trips, we accounted both for improved travel speeds for buses due to lower traffic and the time savings from fare-free boarding of subways and buses; as we discuss below, the projected increase in ridership from eliminating transit fare collection is anything but insignificant, particularly for buses. Third, to calculate traffic bounceback, we invoked the "cross-elasticity" of auto trips with respect to transit trips — the extent to which a new transit trip comes at the expense of

TABLE 4: Some Results of Traffic-Equilibrium Analysis for Free Transit		
	WORK TRIPS	NON-WORK TRIPS
Decrease in Price of Trip	100%	100%
Price-elasticity of Transit Trips	–0.09	–0.234
Increase in Transit Trips due to price ("#1")	9%	23.4%
Decrease in Time of Trip (Subway / Bus)	3% / 20%	2% / 20%
Source: MTA studies of Bus Rapid Transit (for buses); Kheel Study Team (for subways)		
Time-elasticity of Transit Trips	–.50	–.55
Incrs Transit Trips due to time ("#2") (Subway / Bus)	1.5% / 12%	1.1% / 13%
Tot. Incrs Transit Trips (#1 + #2) (Subway / Bus)	10.5% / 18.4%	24.5% / 33.8%
Cross-Elasticity of Auto Trips w/r/t Transit Cost	0.95	0.50
Numbers in prior row denote number of auto trips lost per transit trip gained by lowering its cost.		
Average auto occupancy	1.2	1.5
Calculated Reduction in Auto Trips into CBD	24%	16%
Figures above reflect roughly 36-to-1 proportion of subway to bus trips into CBD.		
Improvement in Travel Speed (first iteration)	7.2%	5.9%
Time-elasticity of Auto Trips to the CBD	–1.00	–1.24
Increase in Auto Trips (first bounceback iteration)	7.2%	7.4%
Reduction in Auto Trips (net after seven iterations)	20%	12%
Share of Initial Reduction Re-attracted by Bounceback	15%	25%

an auto trip. Fourth, we applied estimated car occupancy rates to credit autos for sometimes having passengers and not just a driver.

The resulting analysis comprises many steps which are difficult to encapsulate in print. We thus present them schematically in Table 4. (They are linked and derived in the BTA spreadsheet model. They are also discussed at somewhat greater length in the ***Transit Analysis***.)

Carrot and stick: cordon fee and free transit combined



For the parameters chosen — a $16 cordon entry fee, and half of the effective gain in CBD lane capacity reserved for non-auto use — the two policies separately are projected to reduce work trips by private auto by 17% and 20%, respectively, and non-work trips by 33% and 12%, respectively. However, these results aren't additive if the policies are combined. This is because some current auto trips get counted in both categories (i.e., some auto trips are ripe for being tolled off the roads and attracted by free transit). Assuming for simplicity that these trips are distributed independently, the policies' combined impact may be estimated by applying the Law of Complements, i.e., by multiplying the respective probabilities that a trip is neither tolled off nor lured away (i.e., that a trip "survives" both policies) and then subtracting that joint probability from one. The results are summarized in Table 5.

Trucks and Taxis under a Cordon Fee

Trucks constitute around 65,000 (7-8 percent) of the 870,000 vehicles that enter the Manhattan CBD daily. We propose charging them double the $16.00 entry fee for automobiles, i.e., $32.00 each. Although this would lead to some reduction in their volumes, we nevertheless assume no change, both for conservatism and to simplify the analysis.

Photo: Shutterstock

Taxis are a considerably larger presence in the CBD than are trucks — we estimate that medallion taxicabs comprise 15% of the 800,000 automobiles entering the CBD on a typical weekday — and they warrant special treatment. Instead of charging taxis a cordon entry fee, we assume that taxi fares are raised 25% and that the entire metered increase (excluding tips) is taxed by the city as a surrogate congestion fee. We further assume that demand for taxi service has a price-elasticity of 0.22 and a time-elasticity of 0.50; both values are roughly half of the respective elasticities for auto commutes (work trips) into the CBD. We also assume that of the auto trips lured away by free transit, 5% are taken from medallion taxicabs. The product of these assumptions is a 2% reduction in taxi trips into the CBD. When this result is folded into the declines in auto work and non-work trips shown in the previous table, **the combination of a $16.00 cordon fee and free transit is projected to eliminate 32% of all automobile trips into the Manhattan Central District on a typical weekday.**

TABLE 5: Summary of Traffic-Equilibrium Analysis for $16.00 Cordon Fee

	WORK TRIPS	NON-WORK TRIPS
Share of CBD Auto Trips "Tolled Off" by Cordon Fee	**17%**	**33%**
Share of CBD Auto Trips Surviving Cordon Fee	**83%**	**67%**
Share of CBD Auto Trips "Lured" by Free Transit	**20%**	**12%**
Share of CBD Auto Trips Surviving Free Transit	**80%**	**88%**
Share of CBD Auto Trips Surviving Both Measures	**66%**	**59%**
Figures above are product of multiplying respective survival rates.		
Share of CBD Auto Trips Eliminated by Measures	**34%**	**41%**
Figures above are one minus respective survival rates.		

REVENUE ANALYSIS

The new "regime" of a cordon entry fee and free transit provided by the Kheel Plan will create three new revenue streams: (i) from the $16 cordon fee ($32 for trucks and buses); (ii) from the surcharge on medallion taxi revenues; (iii) from managing curbside parking in and north of the CBD for greater turnover and revenue, as described below.

There are four revenue streams under the present regime: (i) existing tolls to cross the Hudson and East Rivers; (ii) farebox receipts for subways and buses; (iii) farebox receipts for intra-city commuter rail trips (which will decline in tandem with the subway fare, under our plan), and (iv) farebox receipts for MTA Bus Co.'s express and local bus service. Here we summarize our comparison of "new" revenues (under the Kheel Plan) vs. current revenues.

TABLE 6: Agency Costs and Benefits
Costs are in Millions of Dollars per year. Parentheses denote net loss.

REVENUE OR COST	GAINS	LOSSES	NET GAIN
Motor Vehicle Tolls	$2,950	$550	$2,400
Transit Revenues		$2,720	($2,720)
Commuter Rail Revenues		$60	($60)
MTA Bus Co. Revenues		$140	($140)
Taxi Revenues	$340		$340
Expanded CBD curbside parking charges	$700		$700
Operational savings from eliminating farebox	$170		$170
Cordon Administration		$50	($50)
Costs to serve increased transit ridership		$180	($180)
TOTAL	$4,160	$3,700	$460

Current (2006) NYC Transit farebox revenues were $2,716 million (rounded in Table 6), of which $1,938 million were from subways and $778 million were from buses. (See **Revenue** worksheet of the BTA spreadsheet.) Under the free-fare program, these revenues will be foregone. How will they be replaced?

Most of the loss, $2,400 million, will be made up by replacing the patchwork tolling system (in which many bridges and tunnels are tolled at varying rates, and some aren't tolled at all) with a uniform $16.00 entry fee ($32.00 for trucks). *This revenue estimate takes into account the shrinkage in the pool of vehicles entering the CBD due to the price-elasticity phenomenon discussed in* **Traffic Analysis**. We further estimate that the medallion taxi surcharge will generate $340 million in new revenues. The sum of these two revenue gains, $2,740 million, is effectively identical (given the magnitudes of the numbers) to the lost subway and bus farebox revenues.

Some supporting details follow.

Toll Revenue Increase ($2,400 million) — Presently, an estimated 680,000 private autos and 65,000 trucks (along with 120,000 medallion taxis and 5,000 buses, none of which will be tolled) enter the CBD daily on weekdays. Based on agency data compiled in the BTA, these trips generate $550 million annually for the Port Authority and the MTA. Under the new regime, the 680,000 daily autos become 429,000 paying $16 each, while trucks, unchanged in daily volume at 65,000, each

pay $32. The resulting daily revenue is $8,944,000. Applying the agencies' standard "weekday-to-year multiplier" of 330 (reflecting somewhat lower traffic volumes on weekends), the annual revenue is $2,950 million. Netting the current toll revenues, the increase is $2,400 million.

Taxi Surcharge ($340 million) — Taxi volumes will be buffeted in two directions by the new policies. The faster speeds into and inside the CBD will reduce trip times and increase demand, but our taxi surcharge of 25% (which will net to 21% when reduced waiting-time charges are included) will suppress demand. When these competing effects are fully accounted for, the current average volume of 521,000 fare trips daily for medallion taxis is projected to remain nearly constant, at 507,000. Taxi fares currently average $9.61, without tips. If, as we propose, the entire (net) 21% surcharge is taxed, the resulting daily revenue (calculated as $9.61 x 0.21 x 507,000) will be approximately $1,045,000. The annual tax proceeds, calculated by multiplying daily revenue by 330 (as above), are $340 million.

CBD Curbside Parking ($700 million) — Parking policy is, finally, receiving recognition as a crucial element in traffic management. For one thing, the availability of some 22,000 unmetered curbside parking spaces within the CBD acts as a powerful inducement to drive. At the same time, the fierce

PARKING

Manhattan south of 96th Street has an estimated 59,000 curbside parking spaces. The Kheel Plan proposes to more than triple the number that are metered, from 14,000 to 47,000; or, viewed from the other side of the lens, to reduce the number of unmetered spaces more than three-fold, from 45,000 to 12,000. Per-hour parking rates would rise too, while the hours of free parking shrink. Taken as a whole, these changes are almost as radical as the cordon fee itself. Some background is therefore in order.

The high cost of *off-street* parking in Manhattan garages and lots exceeds the cost of any proposed cordon fees, revealing that some people will use cars for some trips at almost any price. But for the preponderance of New Yorkers, the deterrent effect of high parking charges in the Manhattan CBD has long demonstrated that pricing works. That an estimated 60% of CBD-bound drivers manage to park for free proves the importance of parking cost and availability in the choice to drive.

The hope of finding a free parking spot motivates many drivers to cruise almost endlessly (adding to congestion), indicating that free parking is too abundant and metered parking is too scarce. Curbing congestion requires pricing parking as well as roads at levels that maintain access without clogging streets. Moreover, with the price of off-street parking rising in tandem with the price of adjacent real estate, the City's undercharging for street spaces means it is squandering hundreds of millions of dollars of public assets a year.

This explains the Kheel Plan's proposal to cover not just the CBD but the adjacent area most vulnerable to spillover parking by drivers who might seek to avoid charges to cross 60th Street. While actual meter fees would vary with proximity to high demand areas, the average rate would be roughly triple current meter fees between 7 a.m. and 6 p.m. However, rates would be much lower in "shoulder" hours at either end of the work day and free after 8 p.m.

Extending parking pricing from 60th to 96th Street promises benefits beyond reducing "border effects" from the cordon congestion charge. It would provide an equitable way for Manhattan auto owners to contribute to congestion pricing, without imposing unworkable daily trip charges. It would reduce and perhaps eliminate parking cruising, since meter rates would be set to levels that ensure one vacant space on each side of each block. Businesses would benefit from easier customer access due to faster parking turnover. Residents would not be locked into their spaces. And everyone would be rewarded by our proposal to allocate a third of the revenues in this largely residential district, an estimated $90-$100 million a year, to making streets and sidewalks more conducive to walking, cycling, sitting and enjoying public space.

The balance of the revenues, combined with the increased parking charges in the CBD, would total $700 million a year, adding significantly to the cordon fee's capacity to support and improve free transit throughout New York City.

Curbing congestion requires pricing curbside parking as well as roads.

competition for these spaces makes "parking cruising" a major (and egregious) component of Manhattan's chronic traffic congestion.

The city now charges for parking at approximately 7,000 curbside spaces within the CBD for 10 hours per day, 6 days per week, at an average rate of around two dollars per hour, which we assume will be raised to an effective hourly rate of $2.63. (See BTA, **Parking** worksheet.) Assuming a current "revenue factor" of 85% (i.e., each metered space generates 85% of the revenue it would generate if it was occupied and paid for during all 60 hours a week), the (adjusted) annual revenue from CBD curbside metering is $48 million.

Under the Kheel Plan, these revenues would increase dramatically as a result of expanding the number of parking spaces that would be metered, the hourly rates, and the hours in which the rates would be charged. The Kheel Plan would (i) add metering to three-quarters of the 22,000 unmetered curbside paces in the CBD; (ii) raise the rate for all CBD curbside parking to eight dollars an hour during 7 a.m. – 6 p.m., and four dollars during 6-7 a.m. and 6-8 p.m.; and (iii) charge for parking 7 days per week. Assuming a lower "revenue factor" of 75%, this regime would collect an estimated $640 million a year, representing a revenue increase of some $590 million. Factoring in administration and enforcement, the net annual revenue gain is estimated to be $530 million.

A similar expansion of metered parking, albeit at lower hourly rates, to Manhattan streets and avenues from 60th Street to 96th Street would generate an additional net revenue of approximately $260 million. We envision allocating one-third of this revenue gain to the local (and largely residential) communities to invest in public space amenities — bicycle lanes, wider sidewalks, plazas, etc. The remaining two-thirds, amounting to $170 million annually, would be made available for transit improvements, bringing the net gain from our curbside parking measures to $700 million — $530 million within the CBD and $170 million from the northern district.

We have *not* credited this proposed system for further reducing vehicular traffic and improving traffic speeds in the CBD and the rest of the city. This could, and should, be done in a subsequent analysis.

Finally, the loss side of the revenue equation under the Kheel Plan includes an estimated $430 million from the four sources itemized below (words in bold denote worksheet tabs in the Balanced Transportation Analyzer in which the estimates are derived):

- $60 million in lost revenue from Metro-North and LIRR intra-city rail passengers (**Revenue**)
- $140 million in lost revenue from MTA Bus Co. passengers, mostly in express bus service (**Revenue**)
- $50 million in annual costs (operations plus amortized capital costs) of cordon-tolling administration (**Cordon**)
- $180 million in annual costs (operations plus amortized capital costs) of the expanded subway, rail and bus service required to service the increased ridership and reduce subway crowding (**Subway Costs**)

Table 6 displays and sums the various revenue gains and losses. The net change is an estimated annual increase of $460 million in funds available to the transportation and transit agencies serving New York City.

COST-BENEFIT ANALYSIS

The travel changes engendered by simultaneously instituting free transit and imposing a steep charge to drive into the Manhattan CBD will significantly alter the costs and benefits of transportation throughout New York City. A key part of our analysis was to quantify these changes and "monetize" them — express them in dollar terms.

We concentrated on four key areas: (i) lost or gained **travel amenity**; (ii) **time savings** due to lesser traffic; (iii) **reductions in pollution** and other "externality" costs from motor vehicle use; and (iv) **health benefits** from the uptake in cycling and walking. Our analysis is presented in the **Cost-Benefit** worksheet of the Balanced Transportation Analyzer. We summarize it here. (Note that below we use approximate values for some parameters; see BTA for calculations.)

The reduced traffic stream due to the cordon fee and free transit will raise traffic speeds inside the CBD and citywide.

Lost or Gained Travel Amenity • net cost of $360 million — The car trips that will no longer be taken (due to the cordon entry fee or the advent of free transit) formerly provided utility to the trip-takers. "Tolling these trips off the road," or even luring them into free subways and buses, thus exacts a cost on the people now taking them. The lost value of these trips is real and belongs on the negative side of the benefit-cost ledger. Of course, the gained value of new transit trips attracted to free buses and subways is just as real and should be counted on the plus side.

It's a relatively straightforward matter to estimate these costs and benefits. Consider the roughly quarter-of-a-million daily auto trips now taken into the CBD that will no longer occur. We can infer their current value to the trip-takers by considering that what caused their disappearance was a $13.00 (average) increase in the cost of each trip (that's the difference between the roughly $3.00 average round-trip toll now paid by drivers into the CBD and the proposed $16.00 one-way cordon fee). Current trips whose net value to the driver is today greater than $13.00 will continue to take place, since their new net value will still exceed zero; and of course any current trip whose net value to the driver is less than zero is not being taken in the first place. This implies that *the trips that will be tolled off the road by the cordon fee are all those that today are worth between zero and $13.00*. A reasonable approximation of their average value today is then the arithmetic mean of zero and

TABLE 7: Economic, Social and Environmental Costs and Benefits
Figures are in Millions of Dollars per year. Parentheses denote net loss.

REVENUE OR COST	GAINS	LOSSES	NET GAINS
Motor vehicle users' saved time	$3,870		$3,870
Changes in mobility	$220	$580	($360)
Reduced crash damage costs	$420		$420
Reduced driver insurance costs	$70		$70
Reduced climate damage	$40		$40
Reduced air pollution health / enviro damages	$290		$290
Reduced noise costs	$150		$150
Longevity benefits of more biking / walking	$1,020		$1,020
TOTAL	$6,080	$580	$5,500

$13.00, which is $6.50. That is the average net value today of each trip that will disappear due to the cordon fee. Carrying through the math (254,000 daily trips x $6.50 per-trip value x 330 weekday equivalents per year) yields $540 million for the aggregate lost amenity to drivers of abandoned trips into the CBD.

The same logic applies to the roughly 180,000 daily trips *outside* the CBD that will similarly disappear, due to the allure of free transit. These trips have an average "revealed" value less than $13.00, however, since they are, in effect, eliminated not by a "$13.00 carrot" but by a "$1.20 stick," the latter being the average fare saved by the advent of free bus and subway service. That is, for the "bribe" of free transit to lure a driver from a car trip, that car trip today must be conferring a net benefit no greater than $1.20, else the $1.20 savings from free transit wouldn't alter the driver's decision. Ascribing an average value of 60 cents to these trips leads to a calculation (via 180,000 x $0.60 x 330) of $40 million (rounded) for the aggregate lost amenity to drivers from trading non-CBD trips for free transit.

Combining the $540 million in lost amenity from reduced CBD auto trips, and $40 million in lost amenity from non-CBD car trips won over to free transit, the total loss in amenity to drivers under the Kheel Plan is $580 million.

Finally, just as the foregone auto trips represent a loss in value to drivers, the new transit trips constitute a gain in value for these straphangers. Counting only brand-new trips that are taken on transit (i.e., *not* counting those new transit trips that replace auto trips), we estimate close to 1.1 million new daily trips with an average net value to the trip takers of 60 cents (the mean of a range of zero to $1.20). The actual calculation (1.1 million x $0.60 x 330) yields $220 million as the estimated annual amenity value of new trips attracted by free transit.

Summarizing: present-day drivers lose $580 million in amenity from taking fewer car trips; present-day stay-at-homers gain $220 million in amenity by taking more transit trips. Combining these figures yields a net loss of $360 million in travel amenity due to our combination of free transit and cordon fee.

BALANCING COSTS AND BENEFITS

Economic theory instructs firms to set prices at the point where a penny more (or less) would reduce earnings. The same logic would command governments to set tolls at the level that maximizes society's net benefits, i.e., where a dollar more or less would cut into those benefits.

But government is not a business, and the $16 cordon price we selected for the Kheel Plan appears to be below the optimum price. We infer this from observing from the BTA that raising the price to $17 would reduce the gross utility of drivers' trips by only $50 million while creating $90 million in societal benefits ($10 million from fewer traffic crashes, $10 million from reduced air pollution, $20 million in increased longevity as the drop in traffic encourages more bicycling and walking, and $50 million in saved time — most of which would accrue to people taking car trips despite the toll).

A similar exercise for a $15 toll also reveals lower net benefits than at $16.

To be candid, our $16 cordon fee reflects our judgment of what the political system might now allow. It is also a round number of sorts, equal to twice Mayor Bloomberg's proposed fee in PlaNYC and roughly matching the level in European cities with congestion charging.

Someday, the fee might be set higher. Then again, in the not-too-distant future we can look forward to a GPS-enabled charging scheme that levies a socially appropriate fee to drive that reflects congestion responsibility, transit alternatives, vehicle size and weight, etc. Such a scheme could start in the CBD, thus capturing intra-zonal vehicle use, and eventually go citywide.

Goodbye cordon fee; hello, universal graduated road pricing.

Time Savings due to Lesser Traffic • benefit of $3.87 billion — The reduced traffic stream due to the cordon fee and free transit will raise traffic speeds inside the CBD and citywide. The projected speed gains are impressive: in the CBD, from a current average of 8 mph to 10.7 mph (a 34% gain), and for the rest of the city, from 25 mph currently to 27.5 mph (a 10.2% gain).

Calculating the corresponding hours of saved time is simple; it requires specifying only the current volumes of traffic, which are recorded by the transportation agencies, and then imputing an average value for each hour now spent in traffic that will be saved by reducing traffic congestion. The estimated annual time savings are 26 million vehicle-hours within the CBD, and 78 million vehicle-hours outside. (See BTA for details.)

Assigning monetary values to these hours is more complicated. Fortunately, members of the study team encountered the same issue four years ago in researching and writing ***The Hours***, a cost-benefit analysis of tolling New York City's free East River bridges. In that report, we calculated a weighted-average value of time in traffic leading to and traversing the bridges, for nine vehicle types covering the gamut from single-occupant vehicles and trade vans to buses and 18-wheelers. Using estimates ranging from a low of $7.50 - $15.00 per vehicle-hour for off-peak single-occupant vehicles that were estimated to constitute 25% of the traffic stream, to $150-$300 per vehicle-hour for the 2% of traffic made up of "big rig" 18-wheelers, we calculated an average per-vehicle cost of time in traffic of approximately $43 per hour.

That figure, adjusted for inflation (to $48.60/hr), is a reasonable estimate for the average value of vehicle-hours saved within the CBD; for time saved in the rest of the city we use half that value, or $24.30 a vehicle-hour, on the theory that the time value of drivers (and their cargo) outside the CBD is less than for CBD trips, on average. Multiplying these hourly values by the respective millions of vehicle-hours noted above yields **$1,270 million** ($1.27 billion) for the value of time savings in the CBD, plus **$1,900 million** ($1.90 billion) for time savings in the rest of the city.

Bus riders will be perhaps the greatest beneficiaries of time savings from the new policies.

That's not all, however. Bus riders will be perhaps the greatest beneficiaries (proportionally) of time savings from the new policies. The advent of fare-free boarding and the resultant marked speedup of bus movements will be a great boon for time-conscious bus passengers.

We assume an average NYC bus speed of 9 mph and an average rider trip of 2.5 miles, which together imply that a typical bus trip consumes 16.7 minutes of travel time, per rider. (These assumptions and the associated calculations are documented in the BTA.) We have estimated that eliminating on-board fare collection, coupled with the lighter traffic, would increase bus travel speeds by 20%, which would shorten a typical trip by 3.3 minutes. Moreover, passenger waiting times would also drop as buses were able to cover their routes more quickly. We estimate 0.8 minutes for that saving, resulting in a total time savings averaging 4.2 minutes (after rounding) per ride, primarily due to eliminating bus fare collection, with a further boost due to reduced traffic levels generally.

Applied to current bus ridership, 741 million passengers per year, the estimated citywide time savings from eliminating bus fare collection are approximately 52 million hours per year. We apply a 2003-value of $12.00 an hour for bus riders' time ($13.60 in 2007), which yields a valuation of annual time savings for bus riders due to eliminating fare collection of $700 million. Combining the three

time-savings categories (lighter traffic within CBD, lighter traffic outside CBD, and fare-free buses) yields an annual total of $3.87 billion.

Reduced Pollution and Other "Externality" Costs from Motor Vehicle Use • benefit of $970 million — The anticipated 8.9% reduction in citywide motor vehicle use ("VMT," or vehicle miles traveled, in the parlance of traffic analysts) should be expected to reduce traffic crashes and pollution by roughly the same proportion. Some reductions might be disproportionately greater, e.g., air and climate pollution, owing to the tendency of gasoline and diesel engines to burn fuel more efficiently and emit fewer pollutants when not forced to operate at gridlock speeds. Other reductions might be less than proportional, e.g., for noise pollution, since the physics of sound dictate that, for example, removing one out of ten identical 65-decibel noise sources reduces their aggregate noise only marginally, by around half a decibel.

With fewer cars, the urban environment would become more conducive to walking.

On balance, however, an assumption of proportionality is reasonable. Car crashes, for example, should be expected to drop in tandem with the decline in VMT. Thus, the approximately 300 annual motor vehicle crash fatalities in the city will probably fall by 25 to 30.

We examined four categories of externalities from motor vehicle use in New York City: *crash fatalities and injuries, air pollution* (emissions such as particulates and carbon monoxide), *climate pollution* (carbon dioxide, the primary greenhouse gas) and *noise*. For three of the four, we drew on the authoritative, 15-year, 20-volume study of the "Annualized Social Cost of Motor Vehicle Use in the U.S., 1990-1991," by the highly regarded University of California (at Davis) researcher Mark A. Delucchi. Dr. Delucchi not only rigorously analyzed all of the major types of damages resulting from motor vehicles, he monetized them by applying consensus valuation of health effects including the cost of premature death.

Updating Delucchi's figures to 2007 prices and adapting them as needed from national to New York conditions, we estimated the savings from the 8.9% citywide VMT reduction to be $420 million for fewer crashes (in the form of avoided fatalities, injuries, property damage and public administration), $290 million for reduced air pollution (primarily health benefits) and $150 million for reduced noise pollution. We separately estimated that the reduced crashes should translate into additional savings of $70 million in lower car insurance premiums (this is aside from the lower societal costs of car crashes themselves, and assumes that half of the actuarial savings are passed on to customers). The three categories (plus the insurance savings) sum to $930 million in annual savings for New Yorkers.

For the case of climate pollution, a category whose prominence postdates Delucchi's study, we applied our own method, based on an assumed value (or cost) of atmospheric carbon emissions of $100 per ton (equivalent to roughly $27 per ton of CO2). This is toward the upper range of the carbon price built into carbon tax legislation introduced in Congress this year, although it is less than what the lead author of this report, among others, regards as the true cost in terms of likely environmental and human damage. Applied to the 355,000 tons of carbon that would be saved through the reduced fuel use associated with less use of motor vehicles in the city, the implied value of the climate pollution averted by the proposed policies is approximately $40 million per year.

This figure is notably smaller than the savings associated with the other categories of reduced pollution. This suggests that the more mundane ills from automobile use in urban environments — noise, fumes, and crashes — are even more damaging to human beings than the likely climate disruption associated with driving. It also suggests that the real climate benefits of our plan arise not from the

shrinkage in vehicle use itself but from making New York City sufficiently vital and livable to enable the city to attract businesses and residents that would otherwise populate areas, such as suburbs, that don't share the city's structural bias toward carbon efficiency. Of course, blazing a path for hundreds of other "world-class cities" to follow would add to the carbon benefits.

Health Benefits from the Increase in Cycling and Walking • benefit of $1.02 billion — Bicycling and walking aren't just ecologically positive, they're healthful for the cyclists and walkers themselves. Just how beneficial in terms of longevity was documented in a landmark study by a team of epidemiologists and physicians at Copenhagen University Hospital, published in Archives of Internal Medicine in 2000. The decade-long study of over 30,000 adult men and women concluded that bicycling to work decreased the risk of mortality by 28%, after adjusting for age, sex, educational level and leisure-time physical activity. (See BTA, **Cost-Benefit**, for details.)

What does this have to do with cordon pricing and free transit? Quite a lot. The roughly 9% reduction in motor traffic should be expected to evoke a substantial increase in bicycling, both because lighter traffic levels are conducive to cycling and because they will, finally, provide the wherewithal for key infrastructure improvements such as bicycle lanes and parking facilities that have heretofore been held hostage to the imperatives of auto traffic.

While it's not possible to predict precisely how many more New Yorkers would ride bikes if motor traffic fell 9%, we can base an educated guess on cycling levels in Denmark, the Netherlands and Germany, where cycling currently accounts for 23% of urban trips, on average (excluding walking trips). The comparable level in New York City is 2%. We posit that New York's 2% would reach Northern Europe's 23% if (and perhaps only if) motor traffic here disappeared altogether. Extrapolating from that proposition, we conclude that eliminating 9% of motor traffic should increase cycling's share of trips here by approximately two percentage points (9% of the current 21% gap between our 2% and their 23%), i.e., from 2% to 4% (3.9%, before rounding).

We noted above that regular cyclists experience 28% lower mortality than the rest of the population. Accordingly a 1.9% increase in the number of adults who cycle should translate to a 0.52% decrease (1.9% x 28%, without rounding) in New York City's overall adult mortality. Factoring by the average number of deaths among adults ages 20 to 74 (which we define as the target group for the uptake in cycling), the city could expect the rise in cycling due to the lower traffic to cut the number of deaths by 132 a year. (Interestingly, this is 4-5 times larger than the anticipated decline in traffic deaths from fewer crashes estimated above.) Applying a value of $3.8 million per "saved" human life (per Delucchi — see earlier discussion or BTA), the annual value of the greater longevity from increased cycling is estimated to be approximately $510 million.

The health value from the increased opportunities for physical activity attributable to the cordon toll and free transit doesn't stop there, however. More New Yorkers would walk as well, not just because transit trips have a greater walking component than trips by car, but also because with fewer cars the urban environment would become more conducive to walking. (Note that infrastructure improvements wouldn't be limited to bike lanes but could include wider sidewalks and other design amenities; indeed, our plan envisions reserving half of the effective increase in CBD road capacity to cycling, walking and bus rapid transit.)

Moreover, the health value of increased cycling and walking transcends improved longevity to include greater all-around wellness. As the editor of ***Nature Neuroscience***, a highly regarded journal published by the publishers of ***Nature***, wrote recently on The New York Times' op-ed page, "exercise

improves what scientists call 'executive function,' the set of abilities that allows you to select behavior that's appropriate to the situation."

Here's more from that article:

> How might exercise help the brain? In people, fitness training slows the age-related shrinkage of the frontal cortex, which is important for executive function. In rodents, exercise increases the number of capillaries in the brain, which should improve blood flow, and therefore the availability of energy, to neurons. Exercise may also help the brain by improving cardiovascular health, preventing heart attacks and strokes that can cause brain damage. Finally, exercise causes the release of growth factors, proteins that increase the number of connections between neurons, and the birth of neurons in the hippocampus, a brain region important for memory. Any of these effects might improve cognitive performance, though it's not known which ones are most important. (Sandra Aamodt & Sam Wang, "Exercise on the Brain," New York Times, Nov. 8, 2007)

On these considerations, the overall health value from the increase in walking, combined with the non-longevity value of the increase in cycling, should at least equal the longevity value of cycling that we estimated at $510 million above. Conservatively taking a 1-to-1 ratio, the total health value from the cordon toll and free fare would be twice the longevity value of cycling alone, or $1.02 billion.

The full quantitative analysis supporting this section, including underlying assumptions, is in the **Cost-Benefit** tab of the Balanced Transportation Analyzer spreadsheet.

TRANSIT ANALYSIS

Introduction

Each weekday, some 2.5 million people travel via public transit into Manhattan's Central Business District (CBD). These trips use a variety of means — three commuter rail lines, PATH trains, Amtrak, express buses, transit buses, ferries, and subways.

The transit workhorse, of course, is the New York City subway system, accounting for an estimated 1.9 million daily trips into the CBD, 77% of total transit trips. Buses and commuter rail each account for 12% (rounded), although in the peak commuting hour, the percentage on commuter rail reaches 16%. Transit buses would be expected to realize the highest percentage growth under the Kheel Plan, as improved travel speeds resulting from fare-free boarding attract thousands of new riders. However, for the morning peak hour, the biggest ridership increase in absolute terms (28,400) under existing trip distribution would be on the subways. Fortunately, the Plan's dramatic price signals would be expected to shift some subway trips to other transit modes.

The subway system already experiences chronic overcrowding. Our transit analysis therefore focuses on the capacity of the subway system to absorb the thousands of new riders — what we call the ridership "swell" — under the Kheel Plan.

The Peak Hour Problem

The NYC subway system is characterized by a sharp peak in usage each weekday morning during the 8-9 a.m. hour at the start of the business day. By our tallies, which are drawn from "Hub-Bound" travel data compiled annually by the New York Metropolitan Transportation Council (NYMTC), 20% of all weekday subway trips into the CBD occur in that one hour. It is primarily in this peak hour that the capacity of the subway system is challenged to meet the demand for service. Accordingly, it is this hour for which we examine the swell in ridership resulting from the combined impact of free transit and cordon tolls, to determine how the subway system can cope with the additional demand.

Our plan's dramatic price signals will shift some subway trips to other transit modes.

Our examination consists of the following sequence of steps:

1. Estimate the gross 24-hour increase in subway and bus trips into the CBD under the Kheel Plan.
2. Estimate, by subway line, the number of new trips that will occur during 8-9 a.m.
3. For each subway line, estimate the number of trips (existing or new) that could be "off-loaded" onto free in-city commuter rail, transit buses or bicycles, potentially easing the strain on the subway system.
4. For each subway line, calculate the number of additional cars and trains per hour needed to accommodate the net increase.
5. Compare the needed added trains against available track capacity.

The surprising result (reported in the main text) is that the Kheel Plan would slightly lessen subway crowding in the a.m. peak-hour (while increasing riders in off-peak periods which are now and would continue to be less crowded). On a majority of lines, even without adding a single subway car, free

TABLE 8: Effects of Kheel Plan on Trips into Manhattan Central Business District
All figures are person-trips entering the CBD on a typical weekday in 2007.

	AUTO	SUBWAY	BUS	RAIL	BICYCLE
24 Hours					
Estimated 2007	1,068,000	1,916,000	290,100	287,800	45,600
Share of transit trips		76.8%	11.6%	11.5%	
Kheel Plan Gross Impacts	(292,500)	343,900	27,700	49,600	42,600
Total Trips with Kheel Plan	775,500	2,260,000	317,800	337,400	88,200
% change	–27.4%	+17.9%	+9.5%	+17.2%	+93.4%
A.M. Peak Hour (nominally 8-9 a.m.)					
Estimated 2007	78,200	379,300	58,300	82,400	6,800
Share of transit trips		72.9%	11.2%	15.8%	
Kheel Plan Gross Impacts	(26,900)	28,400	1,600	14,200	6,400
Reassignments		(32,000)	14,700	12,200	
Total Trips with Kheel Plan	51,300	375,700	74,600	108,800	13,200
% change	–34.4%	–0.9%	+28.0%	+32.0%	+94.1%

transit combined with a steep cordon fee is projected to cause a net reduction in the number of peak-hour riders. The reason: the price incentives in the Kheel Plan would shift enough peak-hour riders onto alternative means — commuter rail, transit buses and bicycles — to more than offset the gross increase in subway demand. Doing so would provide relief to the most beleaguered lines sooner than major capital projects that are many years and billions of dollars from fruition.

❶ 24-Hour Increase in Subway and Bus Trips into the CBD under the Kheel Plan

This part of the analysis is probably the most complex of the five steps. It unfolds in several stages, most of which are presented in the **Transit** worksheet of our spreadsheet, the Balanced Transportation Analyzer (BTA).

As we noted in the companion piece to this one, the Traffic Analysis, the simultaneous introduction of free transit and a cordon fee will alter the quantity and nature of trips into the Manhattan CBD. "Carrot and stick" is the governing metaphor, with free transit as the carrot and the cordon-entry fee as the stick. As described in the Traffic Analysis, we estimated the separate effects of the cordon fee and free transit and then combined them, applying a mathematical adjustment to ensure we didn't double-count transit trips that might be simultaneously "tolled off the roads" and attracted by the reduced or free fare. An analogous procedure is necessary for this first part of the transit analysis as well.

The carrot: free transit

Free subways, buses and in-city commuter rail (or, in its milder form, free NYC Transit buses and reduced-fare in-city commuter rail, express buses and subways) will attract transit trips as a result of both the free (or cheaper) ride and riders' time savings from eliminating fare collection.

We begin with the time savings. Our estimates of the "time-elasticity" are drawn from the 1977 Tri-State Regional Planning Commission (TSRPC) study cited in the Traffic Analysis: 0.50 for work trips and 0.55 for non-work trips. Translated, these values mean that each 1% shortening in trip duration should lead to a one-half of 1% increase in the number of transit work trips, and a slightly larger (55/100 of 1%) increase for non-work trips.

To what extent would fare-free transit shorten transit trips? The answer appears to be: very modestly for subways but quite significantly for buses.

For subways, we estimate that eliminating the time to purchase and use MetroCards and removing most or all of the physical barriers to enter and exit stations would shorten the average ride by 2 to 3%. (This is our judgment, offered in the absence of any figure from the MTA.) With this assumption, eliminating fare collection would be expected to increase subway ridership by 1 to 1.5% (a smaller benefit may occur from the eventual replacement of MetroCards by contact-less "smart cards").

For buses, in contrast, the estimated time savings are impressive: an estimated 20%. These savings are projected as the joint result of two different facets of free bus service: radically reduced "dwell time" of buses at bus stops, and faster overall traffic flow.

The time consumed in bus travel may be thought of as the sum of the time the bus is actually in traffic and the time the bus is stopped to discharge and receive passengers.

(A third element, passenger wait time, is also important — indeed, we include it in tallying bus riders' time savings under the Kheel Plan, in the **Cost-Benefit** worksheet; but the reduction in wait time is proportional to the other savings estimated here and so does not need to be modeled additionally.)

Dwell time would diminish under fare-free boarding, from eliminating time-consuming and cumbersome card-swiping during boarding and by allowing all doors to be used for boarding and alighting. An internal analysis performed by NYC Transit and provided to us suggested that dwell time would fall by 84% and overall average trip time would fall by 24%. However, this result was based on a model (with stopwatch observations) for a single bus route (the Bx12 Limited from 207th St. to Coop City), and a busy one at that — the city's fifth busiest local bus. We therefore reduce it for conservatism, below. Separately, the reduction in citywide VMT under the Kheel Plan, which we estimate to be approximately 9%, equates to a 9% average gain in bus speeds for the travel-time portion of the trip.

Fare-free boarding would diminish "dwell-time" at bus stops by eliminating cumbersome card-swiping and allowing all doors to be used.

The two trip elements are estimated separately and combined in Section 2A of the **Transit** worksheet. The result is a calculated 31% reduction in overall trip time. We have conservatively reduced this by about one-third, on the advice of our NYC Transit expert; with rounding, this leads to an estimated average reduction in NYC Transit trip times of 20%. With this figure, the time-elasticities given above support estimated bus ridership gains of approximately 12% for work trips and 13% for non-work trips.

Concurrent with the boost to transit patronage due to shortened trip durations, ridership would gain further from the price incentives of reduced or eliminated fares. The applicable price-elasticities, according to the 1977 TSRPC analysis, are 9% for work trips and 23.4% for non-work trips. These relatively low values are consistent with the prevailing view among experts and the public alike that a given percentage change in the quality of service (including on-time performance) has a greater bearing on transit usage than does the same change in the transit price (fare). Still, abolishing the fare is no small change. Even with the modest price-elasticities, outright elimination of the transit fare would be expected to increase ridership by the elasticity percentages: 9% for work trips and 23.4% for non-work trips.

Combining the "carrot" results with those from the "stick" (cordon entry fee)

The cordon fee will also generate new transit trips. According to the TSRPC elasticities, for each 100 work trips by auto that are "tolled off the road," 95 will rematerialize as transit trips; for non-work trips, the analogous "cross-elasticity" is 50%, meaning that 50 out of 100 eliminated auto trips convert to transit including commuter rail (The remainder either convert to carpooled trips, reappear

TRANSIT FARES — FROM 1904 TO TODAY

New York City's first subway line opened on Oct. 27, 1904 with a nickel fare. The first fare hike, a doubling to 10 cents, went into effect 44 years later, in 1948. Over the next 47 years the fare was raised sixteen times, each time after acrimonious public debate. By 1996, the year after the base fare reached $1.50, subway use had fallen by half from the record set in 1952.

The spiral of rising fares and declining ridership finally broke in 1997, with the advent of free bus-subway transfers using the new MetroCard-based automated fare collection system. The MTA added three other fare-discounts in short succession: a free eleventh ride with purchase of a ten-ride farecard, unlimited-ride 7-day and 30-day passes, and the unlimited one-day pass.

The table summarizes the history of fare hikes and fare discounts. The hikes have coincided with reduced use of transit while the discounts have coincided with increased patronage. Evidently, price matters. Nevertheless, in 2003 MTA reverted to its pattern of regular fare hikes. The next increase takes effect on March 2.

NYC Transit Fare, 1904 - 2008

FARE PERIOD START DATE	BASE FARE	INFLATION-ADJUSTED	FARE PERIOD START DATE	BASE FARE	INFLATION-ADJUSTED
10/27/04	$0.05	$0.70	01/01/86	$1.00	$1.74
07/01/48	$0.10	$0.85	01/01/90	$1.15	$1.74
01/01/50	$0.10	$0.81	01/01/92	$1.25	$1.73
01/01/52	$0.10	$0.76	11/12/95	$1.50	$1.93
07/05/53	$0.15	$1.03	07/04/97	$1.50	$1.88
07/05/66	$0.20	$1.17	01/01/98	$1.50	$1.87
01/04/70	$0.30	$1.53	07/04/98	$1.50	$1.85
01/05/72	$0.35	$1.54	01/01/99	$1.50	$1.73
09/01/75	$0.50	$1.60	05/04/03	$2.00	$2.16
06/28/80	$0.60	$1.40	02/27/05	$2.00	$2.00
07/03/81	$0.75	$1.56	03/02/08	$2.00	—
01/02/84	$0.90	$1.72			

Inflation-adjusted fare uses the average Consumer Price Index for each fare period, e.g., the nickel fare is adjusted for the mean of the CPI's for 10-27-04 and 6-30-48. Base (= 100) is Aug. 30, 2006 — midpoint of last known fare period. Multiple periods with same base fare denote changes in transfers and other discounts that are too elaborate to show here. Base fares (and inflation-adjusted counterparts) do not reflect available discounts.

as non-motorized travel, or disappear.) This is consistent with London's experience after introducing congestion pricing in February 2003, and with the assumptions of PlaNYC.

Accordingly, we took our estimates of the number of priced-out car trips into the CBD, multiplied them by the estimated number of occupants (1.2 for work trips, 1.5 for non-work) and factored them by the cross-elasticities given above. This yielded a gross estimate of the number of new transit trips into the CBD resulting from the cordon fee.

We thus have three sources of new transit trips: trips induced by faster transit, trips induced by cheaper transit, and trips replacing costlier auto trips. Simply summing the respective increases could lead to overcounting, because of both the overlap between factors (e.g., the same new transit trip could have been attracted by both the faster trip and the cheaper trip) and as a consequence of bounceback, whereby some of the increased trips due to the cordon fee are then offset by the re-attraction of car trips to roads that are now less crowded and thus allow faster travel. The mechanics of these adjustments are rather complex to narrate, and are best comprehended by examining Sections 2, 4, 5, 6 and 9 of the **Transit** worksheet of the BTA (Balanced Transportation Analyzer) spreadsheet.

There, the results are disaggregated by mode (subway and bus) and type of trip (work and non-work). Separating the estimated 24-hour weekday increases in trips into this 2x2 form was essential for properly assigning the increased transit trips not only to respective modes, but also to the critical peak hour (8-9 a.m.).

❷ Estimate, by subway line, the number of new trips that will occur during 8-9 a.m.

This step is carried out in two BTA (Balanced Transportation Analyzer) worksheets — **Transit** and **Assignments.**

The process begins in Section 9 of the BTA's **Transit** worksheet, which breaks out the new subway (as well as bus) trips not only by work or non-work, but according to which trips were attracted to free transit and which were priced out of automobiles.

The latter distinction is important for estimating the time distribution of the new trips. CBD trips attracted to free transit would be expected to conform to the hour-by-hour distribution of existing transit trips, whereas trips priced out of cars (due to the cordon toll) should follow the current time distribution of car trips into the CBD. The two sets of distributions are quite different, with transit trips exhibiting a far sharper hourly peak. These calculations are performed in Section 9 of the **Transit** worksheet and summarized in Section 10.

The important finding from this stage — at least under the cordon fee and free-transit assumptions of the Kheel Plan — is that the vast majority of the new transit trips that are for the purpose of work, and a large share of non-work trips as well, came from autos. Accordingly, the temporal distribution of these trips will largely follow the current temporal distribution of auto trips. The next step, then, is to estimate the percentages of 24-hour car trips into the CBD that now occur in the peak hour (ditto for non-car trips).

These calculations are performed in Part 3 of the **Assignments** worksheet. Data from the NYMTC Hub-Bound Travel Survey (summarized in Part 1 of **Assignments**) indicate that 6.7% (approximately 1 in 15) of auto trips into the CBD arrive between 8 and 9 a.m. Similarly, other NYMTC data — from the agency's Household Interview Survey (last conducted in the late 1990s) — classify slightly more

than half of all CBD-bound auto trips, 52.2%, as work trips (with the remaining 47.8% thus being non-work).

If every 8-9 a.m. CBD auto trip were a work trip, then the percentage of all CBD auto work trips occurring in that hour would be 12.9% (calculated as 6.7% divided by 52.2%). To allow for deviation from that premise, we reduced that percentage (12.9%) by one-tenth, resulting in a figure of 11.6% for the percentage of CBD work trips that arrive during 8-9 a.m. An algebraic calculation leads to the analogous result that only 1.4% of non-work auto trips into the Central Business District arrive during the 8-9 a.m. peak hour. (While that figure may seem low, it is consistent with the idea that most non-work auto trips are discretionary and are thus scheduled to avoid times of peak gridlock.)

Over the past decade, introduction of transit fare discounts has coincided with increased ridership.

A similar set of calculations for CBD subway trips yields these approximate results: 25% of subway work trips to the CBD, and 7% of non-work subway trips, arrive between 8 and 9 a.m.

We then combined the various "cross-products" (e.g., new 8-9 a.m. work trips via subway and new 8-9 a.m. non-work trips via subway) for subways and buses, respectively. The resulting sums (which include 28,400 subway trips and 1,000 bus trips) were then assigned to the 18 subway lines into the CBD and the two PATH lines, in proportion to each line's current share of subway (and PATH) trips into the CBD during the same peak hour.

Let us take the Lexington Ave. Express line as an example. Based on Hub-Bound travel data (collected for 2005 in Part 1 of **Assignments**, updated to 2007 in Part 2), out of an estimated 379,325 subway (plus PATH) trips into the CBD in the 8-9 a.m. hour, some 29,746, or 7.8%, use the #4 or #5 line. We therefore assigned 7.8% of 28,400, or 2,226, of the new peak-hour subway trips to the Lexington Ave. Express line. The same procedure was used to distribute all of the increased subway trips to the 20 rapid transit lines, as well as the much smaller number of increased bus trips to 10 intracity NYC transit bus lines plus the two tunnels (Lincoln and Holland) carrying bus passengers from New Jersey to mid- and lower Manhattan.

❸ Estimate trips that could be off-loaded onto commuter rail, transit buses or bicycles

A key element of the Kheel Plan is to relieve pressure on the subway system by improving provision of other means of intra-city transport on parallel routes. Here we describe our methodology for estimating the extent to which subway trips could be "off-loaded" onto commuter rail lines, transit buses or bicycles.

Commuter Rail

This analysis of intra-city commuter rail encompasses the Long Island Rail Road (LIRR), serving Queens and Brooklyn, and Metro-North Commuter Rail Road, serving the Bronx. New Jersey Transit is not included because it does not provide intra-city service and thus cannot substitute for subway trips.

The analysis is done in six steps, all of which are performed in the **Commuter Rail** worksheet of the Balanced Transportation Analyzer spreadsheet:

a) We estimated the current number of LIRR peak-hour passengers separately for the railroad's Port Washington Branch and its Main Line. This was done by prorating NYMTC Hub-Bound data (see earlier citation) for LIRR peak-hour passenger arrivals by scheduled peak hour cars assigned to the

Main Line and Port Washington Branch. The resulting separation allows appropriate assignment of available LIRR seats to subway lines, in Step (f).

b) For both railroads, we calculated passenger capacity available for the a.m. peak under current conditions. This was done for each line by compiling the number and type of cars that are run during 8-9 a.m. and the seating capacity for each.

c) For the LIRR, we are advocating expanding an LIRR proposal, "Schedule 99" — the LIRR's blueprint for increasing the number of trains entering Penn Station. By reassigning available cars and locomotives, 55 more cars could be deployed in the a.m. peak hour, increasing LIRR peak-hour seating capacity by 6,600. A similar increase in trains is not feasible for Metro-North in the near term, because its equipment is fully deployed in the peak hour. However, Metro-North currently has many more unused peak-hour seats than the LIRR, providing the ability to accommodate more peak-hour riders.

d) We combined the figures from the two prior steps to calculate the number of additional riders that could be accommodated on LIRR and Metro-North trains entering the CBD during the 8-9 a.m. peak hour. These calculations included both the additional cars provided under the LIRR's Schedule 99, and an average of 20 standees per car on a quarter to a half of the trains stopping at NYC rail stations. We then netted the resulting capacities by the existing passenger counts per line to determine each line's capacity to absorb additional passengers.

e) From these capacities, we deducted the estimated number of seats that will be needed to handle new commuter rail riders who would likely shift from automobiles to the LIRR and Metro-North as a result of the cordon fee. Part of this calculation was carried out in Part 5 of the **Assignments** worksheet. There, we separated the number of former car commuters into north of the CBD (for Metro-North) and east of the CBD (for LIRR), and then further disaggregated these by the branches of each system. We also divided these trips into those originating outside of NYC and those starting within NYC, since the former will have higher rates of commuter rail utilization than the latter. The resulting adjustments are shown in Part 5 of the BTA's **Commuter Rail** worksheet. The shifts are substantial, with the influx of new commuter rail passengers estimated to consume 52% of the spare Metro-North capacity and 56% of the spare LIRR capacity estimated to be available in Step (d).

f) The final step in the Commuter Rail analysis was to assign passengers from subway stations, in numbers equaling the net available peak-hour passenger capacity on each LIRR and Metro-North line. Although in most cases these switches would occur distant from the heaviest subway loadings into Manhattan's Central Business District, they would free up capacity on the subway approaches to the CBD. Our assumptions are shown in the **Commuter Rail** worksheet, Part 6. They include: 70% of available seats on the LIRR Port Washington Line assumed to be filled by current or new No. 7 subway riders; 75% of LIRR Main Line seats to be used by E and F train riders; and 70% of Metro-North Hudson and Harlem Line seats to be taken by No. 4 and No. 5 subway passengers. (See BTA, **Transit Capacity** worksheet, for resulting creation of capacity on subways from each commuter rail line.)

The LIRR could raise peak-hour seating capacity by 6,600 by reassigning available cars and locomotives.

The net result of these steps is an estimated 12,200 seats and standing room (conservatively estimated as described above) on the LIRR and Metro-North that could accommodate current or new subway passengers. Would these seats actually be filled? We note that a total of 224,000 people already ride the parallel subway lines into the CBD, not to mention the influx of several thousand more expected under the Kheel Plan. The 12,200 commuters who would need to switch from subway to commuter rail represent only 5% of the total pool. Moreover, commuter rail is an extremely attractive mode, offering a faster ride than parallel subway lines. It thus seems highly likely that at least one in 20 subway riders would choose to switch to parallel

TAXIS

Medallion taxis are a critical travel mode in New York City, accounting for 6% of all motor vehicle trips and a far greater share of vehicle trips in the CBD. The 12,779 medallion cabs are an economic powerhouse as well, generating $2 billion a year in revenue and providing jobs for over 40,000 drivers.

Subjecting taxicabs to the cordon fee is clearly impractical, since most cabs enter and re-enter the CBD several times or more daily. (An average 10-hour shift generates 31 fares, so a taxi used for two shifts has 62 fares a day.) Presumably, meters could be programmed to override the cordon fee after being charged the day's first toll, but socking that fee to the first unlucky passenger is impractical. And subsequent fares would lack internalization of congestion costs and incentives to economize on taxi use.

Instead, we settled on a 25% surcharge on medallion taxi fares, with the entire increase taxed for revenue. (The actual fare increase would work out to less, around 21%, on account of less waiting time due to reduced gridlock.) While a different level might be justifiable, our chosen surcharge leads to two felicitous results: (i) little change in overall taxi use (a projected 2% drop in trips into the CBD, 3% citywide), and (ii) a projected 17% increase in fares per shift to an average of 36.6, from 31.2 currently, due to improved traffic flow.

The heightened productivity implies a decrease in the number of cabs and drivers, but the drivers that remain would be in line for higher earnings. The Kheel Plan therefore preserves the taxi industry while offering taxi workers improved compensation and working conditions.

in-city commuter rail, once the latter were made free or reduced-fare (in tandem with a reduced subway fare). At the same time, we think it is unlikely that these transfers would overly burden the commuter rail lines, since many subway passengers who currently board at the beginning of lines where they can generally get a seat would probably be reluctant to change to a commuter train on which they would have to stand.

NYC Transit Buses

By our count, several dozen NYC Transit bus lines operate on eighteen avenues or via bridges and tunnels that closely parallel subway lines into the Central Business District. Also by our estimates, which are presented in the **Transit Capacity** worksheet, these lines today provide a total of approximately 30,200 seats into the CBD during the 8-9 a.m. peak hour while carrying only 19,200 passengers in the same hour in 2005. Even allowing for growth to 2007 as well as the modest swell due to the price incentives in the Kheel Plan (recall that 97% of all new peak-hour subway or bus trips into the CBD are projected to be by subway), total peak-hour ridership on these lines would be just 19,600, implying additional-passenger capacity of 10,600 and an average capacity utilization rate of only 65%. (On a line-by-line basis, the corresponding "volume-to-capacity" (V/C) ratios range from a low of 0.34 on the M-57 bus on West End Ave. in Manhattan, to a high of 0.90 on the M-31 on York Ave., also in Manhattan.)

Moreover, NYC Transit has already mapped out a plan to purchase 309 additional buses to meet the increased demand for bus service anticipated under Mayor Bloomberg's PlaNYC congestion pricing proposal. (See MTA, "Comments on the New York City Traffic Congestion Mitigation Plan," Oct. 2007, **http://www.streetsblog.org/wp-content/pdf/mtacpreport.pdf**, Table I, New NYCT/MTA Bus Service Required for Congestion Pricing.) Of this total, 171 are earmarked for 10 of the 18 bus routes that provide service into the CBD. By our estimate, the number of peak-hour runs into the CBD that these buses could provide would be only around half of that (171) figure, both because the average duration of these runs is well over one hour and to allow for spares. Still, these buses would

provide an additional 4,300 seats into the CBD in the peak hour, in addition to the 10,600 already available. (This does not reflect plans for Bus Rapid Transit on 1st and 2nd Avenues, for which the MTA is allotting $10.9 million of expected federal funds by 2009 and is seeking another $11 million in 2010.)

We believe that effectively all of these seats — some 15,000 in all, after rounding — could and would be utilized by commuters who either already use the parallel subway lines or who would be drawn to those lines by the cordon fee or the availability of free transit. The attraction would be generated by the faster service the buses would provide due to the advent of fare-free boarding and reduced congestion as well as the more direct service to some major employment areas in the CBD.

To evaluate this hypothesis, we note that a total of 348,000 people already ride these parallel subway lines into the CBD. The 15,000 current and new subway riders who would need to switch to buses to fill the available seats (and thus remove 15,000 passengers from crowded trains) amount to less than 5% of the pool of subway riders, although a slightly higher figure, perhaps 7%, would more realistically allow for line-by-line variation. We think it is entirely plausible that one in every 14 subway passengers would switch to parallel buses that covered their routes considerably faster than at present. Indeed, subway to bus transfer has been the predominant pattern of express bus ridership.

We note further that bus transportation is expected to become even more attractive — both relative to subways and in absolute terms — once NYC Transit implements GPS bus tracking and communications. These systems, now in universal use in London and Paris, enable bus drivers and dispatchers to regulate spacing between arrivals. Even without exclusive bus lanes, GPS should reduce frustrating "bus bunching" and permit accurate real-time waiting times to be posted at bus stops. The combination of fare-free bus boarding and GPS-aided bus management is thus expected to attract many time-sensitive New Yorkers onto buses from autos and taxicabs as well as from subways.

Bicycle commuting is projected to "divert" nearly 5,000 peak-hour subway passengers.

Bicycling

The final element of the troika of modes that we anticipate will relieve subway crowding under the Kheel Plan is the bicycle. This is no afterthought. In our analysis, described here, bicycle commuting is projected to "divert" nearly 5,000 peak-hour subway passengers, adding significantly to the 27,000 seats becoming available by switches to commuter rail and transit buses.

Most of our analysis may be found in the **Bicycles** worksheet of the BTA (Balanced Transportation Analyzer) spreadsheet. The underlying premise is that bicycle transportation in New York City today is artificially suppressed by the high level of motor vehicle traffic, and that, consequently, reducing automobile traffic would lead to increased levels of bicycle commuting.

To quantify this idea, we first noted that roughly 2% of all person-trips in New York City (excluding walking) are made by bicycle, whereas in cities in Northern European countries that have aggressively promoted bicycle transportation through public policy (Denmark, Germany and the Netherlands), the comparable percentage is 23%. We then hypothesized that eliminating all motor vehicle use here would likely lift NYC's 2% bicycle mode share to Northern Europe's 23%; while that is not on the horizon here (nor is it the case in Europe, of course), we hypothesized a prorated version of that relationship: that for each 1% reduction in total vehicle miles traveled in New York City, the gap in bicycle mode share between NYC and Northern Europe would be reduced by 1%.

According to this relationship, the 8.9% reduction in citywide VMT projected under the Kheel Plan should engender a 1.87 percentage point increase in bicycling's mode share (8.9% multiplied by the 21-point difference between 23% and 2% is 1.87%, before rounding). In effect, by raising the share of NYC person-trips (excluding walking) from the current 2% to 3.9%, the Kheel Plan would lead to a near-doubling of bicycle transportation in New York, including bicycle commuting.

Both the arithmetic and the underlying factual basis are provided in the **Bicycles** worksheet. The intermediate results shown there include: 355,000 additional weekday-average cycling trips (pro-rated from the current average daily volume of 380,000 non-commercial trips, i.e., excluding bicycle couriers and food-deliverers); 213,000 of which are projected to end in the CBD, based on current trip distribution; 43,000 of which are projected to begin outside the CBD. This last figure (43,000) is our estimate of new bicycle-commute trips into the CBD. While some of them would replace trips now made by bus, car, taxi or walking, we assume that 75% of them, approximately 32,000, would come from subways.

The shift of 32,000 CBD-bound subway riders to bicycles is a 24-hour figure. We assign 15% of them to the peak hour (8-9 a.m.), implying that 4,800 peak-hour subway seats would become available due to the increase in bicycle commuting under the Kheel Plan. An analogous exercise for buses (which we assume to be the current mode used by 5% of the new bicycle commuters) leads to 300 bus seats similarly becoming available.

The distribution of these seats is performed in the **Assignments** worksheet, Part 6. In lieu of a methodology for predicting the routes used by these new bicycle commuters, we assigned them to the three primary portals into the CBD (other than New Jersey) — north of 60th Street, Brooklyn, and Queens — and further subdivided them into major commuting arteries, according to the current distribution of CBD-bound automobile trips. We then netted these trips from the gross increases in subway and bus commuting predicted for the Kheel Plan. These calculations take place in **Assignments**, Part 10, and the results serve as inputs into the analysis of the demand on subway service that is performed in the **Transit Capacity** worksheet.

Photo: Shutterstock

In-city Commuter Rail, Transit Buses, and Bicycling Combined

Summing the results in this section yields this surprising and heartening finding: *the projected diversion of peak-hour subway demand to commuter rail, transit buses, and bicycling, a combined total of roughly 32,000 passengers, exceeds the anticipated 28,400-passenger increase in peak-hour subway usage from the combined cordon fee and free transit under the Kheel Plan.*

More significant than the precise estimate of this exceedance (predicted to be a modest 3,600 passengers) is the fact that the sign is positive — or, at the least, that the Kheel Plan is highly unlikely to lead to a big net increase in peak-hour subway demand.

❹ For each subway line, calculate the additional cars and trains per hour needed to accommodate the net increase in ridership

NYC Transit calculates V/C (volume-to-capacity) ratios for each subway line based on volumes at the maximum load point, which on some routes occurs considerably upstream from the CBD cordon. The agency's V/C criterion of 1.00 allows 3.0 square feet per standing passenger.

A more progressive and humane approach would seek a reduced V/C ratio. For the Kheel Plan, we chose a space allotment of 3.5 square feet, which is nearly 17% greater than NYC Transit's criterion of

3.0 square feet. Accordingly, we estimated the additional subway trains and cars needed to achieve a minimum of 3.5 square feet per standee during the morning rush period. (The user may enter his or her chosen square footage figure in the **Summary** worksheet of the BTA, and observe the results, further down in the same worksheet, in terms of the number of additional subway cars that will be needed to serve the morning peak.)

The calculations are carried out in the Balanced Transportation Analyzer's **Transit Capacity** worksheet — specifically, in "Column Blocks" C and C-1. The former block of columns performs the calculations for NYC Transit's target space allowance of 3 square feet, while the latter does the same for a 3.5 square foot objective.

Transit Capacity compares the number of peak-hour riders projected for each subway line under the Kheel Plan — taking into account (i) growth in transit ridership from our data year 2005 to 2007; (ii) the "swell" in ridership due to the Kheel Plan's price incentives; (iii) the off-loading of subway riders onto available commuter rail, transit buses and bicycles — against the calculated capacity of each line for the same peak hour (8-9 a.m.). Where capacity exceeds projected ridership, the number of additional cars required is zero; where projected ridership exceeds capacity, the numbers of needed cars and trains are calculated, with rounding "up" since the transit system cannot operate fractional cars and trains. Two sets of calculations are performed: one for NYC Transit's 3 square foot criterion (corresponding to its V/C ratio of 1.0), the other for the 3.5 square foot allowance (corresponding to a V/C ratio of approximately 0.86).

The Kheel Plan will reduce, not increase, peak-hour demand for subway service.

For the various numerical values in our base analysis of the Kheel Plan, we calculate that 211 additional subway cars must be deployed in the peak hour to achieve a (V/C ratio) of 0.86. Interestingly, we calculate that 275 cars would need to be deployed today to meet the same criterion. The higher number needed under today's conditions reflects the finding discussed at the top of this section, that the net impact of the various facets of the Kheel Plan is to reduce, not increase, total peak-hour demand for subway service. (The projected net decrease of 3,600 peak-hour passengers in the aggregate is the equivalent of 36 cars accommodating roughly 100 passengers with a V/C ratio of 0.86. But the subway system is not operated in the aggregate. When the V/C ratio significantly exceeds the target level, not only full cars but also full trains are put into service, if they are available.)

❺ For each subway line, compare the needed cars against available track capacity

The starting point for this final step in the transit analysis is passenger volumes at peak load points on the NYC Transit system. The MTA supplied its most recent such counts for a typical morning peak hour in 2005. Regardless of whether these points are at the Manhattan CBD cordon line or somewhere upstream, the maximum volume governs the level of service for the entire line. The "volume" is the count of passengers on trains, conducted by trained personnel. The "capacity" is for the number of trains scheduled to pass the peak load point in the highest continuous 60 minutes, not necessarily the 8-9 a.m. peak hour. This takes into account the number of cars per train, which is 10 or 11 for the "A" Division (the numbered lines) and 8 to 10 for the "B" Division (the lettered lines), as well as the passenger capacity of the different car classes.

NYC Transit currently schedules 389 inbound trains during the 8-9 a.m. peak (plus 8 on the G line which does not enter the CBD). Somewhat fewer are actually operated, according to NYMTC 2005 Hub Bound data. (For two anomalous lines, the Hub Bound counts were adjusted by trains scheduled in the peak 60 minutes in that year.) The number of cars per train ranges from 8 to 11, with 10 the most common, so that the total number of cars operating in the peak hour is on the order of 3,700.

Passenger volumes are extracted from NYC Transit counts of passengers at the maximum load points in 2005.

With subway crowding an endemic feature of the morning commute on the most heavily used lines, it is natural to assume that the roughly 370 trains and 3,700 cars represent the upper limit of possible capacity for the transit system — i.e., that physical limitations or operational constraints, perhaps safety-related, make it unfeasible to squeeze additional cars and trains into the system to alleviate peak-hour crowding.

The limiting factor in expanding rush-hour subway service isn't track capacity but the availability of cars.

Importantly, *the present service levels are not a ceiling on most lines.* Despite an increase in both peak-hour and 24-hour subway service in the 1996-2005 period, only a handful of subway lines operate at maximum track capacity today. *Historic service levels show that sufficient track capacity exists to increase the number of subway trains deployed during the 8-9 a.m. peak, so long as there are sufficient cars to put into service.*

Our analysis indicates that the same lines that now run 370 trains into the CBD during the morning peak hour could actually operate a total of 556 — a 50% increase. (Data for all lines are presented in the **Transit Capacity** worksheet.) These examples highlight the range of capacity conditions:

- The L in the high-growth Williamsburg area has a V/C ratio of 1.03 but has just been equipped to run trains at close headways, permitting 30 trains per hour instead of the current 15 scheduled and more than the 18 that are planned to go into effect soon;
- The chronically overloaded No. 6 runs 22 peak-hour trains with a reported (and perhaps overly generous) V/C ratio of 1.11. Yet even allowing for delays at 42nd Street caused by high exiting and boarding volumes, it has the track capacity for 27 trains.
- the R train represents the other extreme, where infrequent service from Brooklyn, only 10 trains an hour since the loss of the World Trade Center, discourages ridership and the depressed demand then militates against increased service.

With the Kheel Plan's cordon fees and free transit leading to increased demand on many lines, NYC Transit could and should increase its fleet size by reversing course and retaining some of the cars it intends to scrap as 917 new cars for the B Division are delivered in 2008. Indeed, car retention and reconditioning for 15 more years of service can generally be done for around one-third of the cost of purchasing new cars. The apparent bottleneck, potentially insufficient yard space for overnight storage, can be overcome by storing some cars late at night on mainline segments that do not see regular service, a practice now used to a limited extent. The higher operating cost of maintaining a larger fleet and relying to a greater extent on mainline storage can easily be met through the net revenue gains and productivity improvements that result from the Kheel Plan.

Indeed, one reason for positing a high cordon fee and tapping new sources of revenue is to ensure that sufficient funds are available to outfit, maintain, and operate sufficient trains to make subway riding more comfortable and convenient. According to our analysis, if a Subway Crowding Index of 100% were maintained as the system's comfort criterion, sufficient track capacity exists on every line to meet the demand for peak-hour subway service under the Kheel Plan, following the shifts of some riders to commuter rail, bus and bicycle outlined above and quantified in this report.

Moreover, all but five subway lines could achieve a V/C ratio of 0.86 corresponding to 3.5 square feet per standee during rush hour. Applying this lower-crowding criterion, the remaining deficient lines would be the No. 2, No. 6 and E, each of which would be just one subway train an hour short of meeting the new space target; and the No. 4 and the No. 5, which would fall two trains short,

due to track and dwell time limitations. In fact, the MTA's program to respond to Mayor Bloomberg's congestion pricing plan would add two E and F trains in each of the of the shoulders of the peak to accommodate transferring auto commuters who now exhibit a wider range of travel times.

Again, under a V/C ratio of 0.86, the number of subway passengers in excess of available train and car capacity, summed across the entire system, is approximately 6,200 riders. With transit buses averaging 50 to 55 seats, it would appear to take no more than 120 to 140 additional buses, appropriately deployed, for the Kheel Plan to meet the 3.5-square foot criterion. This target may be brought closer by the planned First and Second Avenue Bus Rapid Transit system which is expected, according to PlaNYC (p. 83), to serve 12,000 daily riders (an estimated 2,400 in the peak hour).

Alternatively, bus capacities could be redefined to include standing room. Applying a bus V/C ratio of 1.20 (i.e., two standees per ten seats), the total number of subway riders that could be off-loaded to transit buses would rise by 6,900, from the current estimate of 14,900. Under this scenario, the same five lines would still be deficient, but with 4,700 "excess" peak-hour passengers, vs. 6,200 when, as above, no standing is assumed on the transit buses operating on the parallel routes.

In either case, meeting the more humane subway loading objective of 3.5 square feet per standee, rather than the current 3.0 foot target, appears to be within the grasp of New York City transit and transportation resources. The caveat in this conclusion is that capacity demands of longer-term population and employment growth have not been assessed in this otherwise conservative analysis.

KHEEL PLAN STUDY TEAM

CHARLES KOMANOFF worked for the NYC EPA (the predecessor agency to the DEP) in the 1970s, and later gained renown as author, researcher and expert witness on cost escalation in the nuclear power industry. Komanoff "re-founded" New York's bicycling advocacy group Transportation Alternatives in the 1980s and remains active in the pedestrian, cyclist and energy-efficiency communities locally and nationally. His books and monographs include Power Plant Cost Escalation, Killed By Automobile, The Bicycle Blueprint and Ending The Oil Age, and his articles have appeared in a range of magazines and newspapers including New York, Orion, The New York Times and the Wall Street Journal. With attorney Dan Rosenblum, Komanoff founded the Carbon Tax Center last year. He graduated from Harvard with honors in Applied Mathematics and Economics. Komanoff lives in lower Manhattan with his wife and two sons.

GEORGE HAIKALIS is a civil engineer and a transportation planner with broad experience in research and analysis. Haikalis was with the Tri-State Regional Planning Commission for nineteen years, where he served as Director of Research, and with NYC Transit, where he was Director of Revenue Budget and Fare Structure Analysis. More recently, he has assisted a number of civic, environmental and community organizations as a transportation consultant. Haikalis is President of the Institute for Rational Urban Mobility, Inc., which hosts a variety of citizen initiatives including Auto-Free New York, **vision42** — a plan to create an auto-free light rail boulevard on 42nd Street — and the Regional Rail Working Group, an informal coalition of rail advocates in the NY-NJ-CT region. He lives in Greenwich Village.

CAROLYN S. KONHEIM has helped shape New York City environmental and transportation policy for over forty years. In the environmental void of the 1960s, she established Citizens for Clean Air, and in the 1970s was an activist city and state environmental official. While leading an environmental firm, Konheim & Ketcham, and consulting for government, she has been in the forefront of battles over Westway, MTA reform and the sustainable redevelopment of her home borough, Brooklyn. As chair of Community Consulting Service, Konheim has used research-based advocacy to help formulate a Brooklyn Transit Agenda, much of the Downtown Brooklyn Traffic Calming Program and Transportation Blueprint, and the case for streamlining congestion pricing via bridge tolls and parking pricing.

BRIAN KETCHAM is a traffic engineer who in a 40-year career has advanced transportation analysis tools while working to restructure the role of automobiles on both the regional and neighborhood level. In the 1970s he drew on his MIT training in race-engine design to build low-emission autos that met Clean Air Act standards. His revolutionary ***Transportation Control Plan*** for the Lindsay Administration opened the debate on East River bridge tolls, parking controls and pedestrian and transit-oriented development. Beginning with exposing NY State's flawed Westway analysis, he has coached two generations of transportation-reform activists, even while consulting for state and city agencies. Through Community Consulting Services, he helps community leaders untangle environmental reviews and press for meaningful mitigation such as congestion pricing.

New York Magazine, June 26, 1972

How to Get the Port Authority Back on the Track

By Theodore W. Kheel

"...A solid and unbreachable wall of law exists between the Port Authority and mass transit. The wall must be smashed..."

SUNDAY NEWS, MARCH 24, 1968

Kheel on Wheels

The Institute for Public Transportation will hold a two-day conference on "Transportation and the Energy Crunch" April 13 and 14 at Armadillo Motor, 48 E. 49th St. Keynote speaker will be Theodore W. Kheel, who will discuss building a more balanced transportation system.

NEW YORK

CHARGES 'PROTECTION' OF P.A. BONDHOLDERS

Kheel assails Rocky, Cahill on transit

How the Establishment Got Theirs: The Defeat of the Transportation Bond Issue

By Fred Powledge

"...Rockefeller, in a fit of lost cool, called Kheel a 'political exhibitionist.' But the Governor's new proposals confirm that the man who led the opposition had been right all along..."

FINAL — DAILY NEWS — NEW YORK'S PICTURE NEWSPAPER — 7¢

KHEEL: DOUBLE BRIDGE TOLLS

Moses Brands Plan 'Illegal'

By RICHARD MATHEU

Theodore W. Kheel, impartial chairman of the transit industry, went Transport Workers Union President Michael J. Quill one better yesterday on ideas for subsidizing the 15-cent fare.

He not only urged, like Quill, that funds be diverted from the Triborough Bridge and Tunnel Authority and the Port of New York Authority to meet the transit deficit — but also called for doubling the two agencies' bridge and tunnel tolls to be sure there would be plenty of money for the fare subsidy.

Theodore W. Kheel

November 17, 1969

How the Port Authority Is Strangling New York

By Theodore W. Kheel

...thority is a dangerously short-sighted and ri...
...oney machine harnessed to serve, not the p...
...private vision of an opportunistic manager...

New York Law Journal

NEW YORK

Justices Divide 4-3 on Bondholder Covenant

Supreme Court Upsets Repeal Of Port Authority Investor Pact

By Alan Rohe

NEW YORK POST — TUESDAY, SEPTEMBER 30, 1969

Kheel Asking Doubled Tolls To Save Fare

The city will ask the Port of New York Authority to double tolls on bridges and tunnels to help save the 30-cent mass transit fare, labor mediator Theodore Kheel announced.

Kheel, appointed by Mayor Lindsay to head a committee to save the 30-cent fare, said the request will be made "sometime this week" when he and Lindsay meet with Austin Tobin, executive director of the Port Authority.

He said the 20-cent fare's "salvation lies with the Port Authority and with the Triborough Bridge and Tunnel Authority."

Kheel said that the Port Authority has been "steaming off all the dough" gained easily from tolls and, in pursuit of...

THE NEW YORK TIMES, FRIDAY, OCTOBER 3, 1969

City Transit Fares of 20c And Higher Seen by Kheel

Rises Starting Next Year Inevitable, Impartial Chairman Reports

By STANLEY LEVEY

Theodore W. Kheel predicted yesterday that all transit fares would rise to 20 cents next year —and to 25 or 30 cents soon thereafter.

The impartial chairman of the private and public transit industries said the self-sustaining-fare provision of the state transit law would make such increases inevitable. He called for repeal of the statute and for subsidization of the city-owned transit system.

Under the self-sustaining rule, the Transit Authority is required to meet operating expenses out of operating revenues. If a deficit results, the agency must raise the fare to balance its books. In the fiscal year ended last June 30, the authority went nearly $13,000,000 in the red, but it offset this by reserves.

In the present fiscal year the authority expects to lose $26,000,000, and available reserves will be insufficient to balance

The New York Times
Theodore W. Kheel

Continued on Page 21, Column 6

THE NEW YORK TIMES, TUESDAY, MAY 31, 1955

AUTOS AGGRAVATE TRANSIT PROBLEM, KHEEL SEEKS CURE

Private Cars Take Riders, Then Snarl Traffic, Thus Slowing Up Buses

By STANLEY LEVEY

Having displaced the horse, the automobile is now inexorably replacing the mass transit facility.

In the process, a twin problem has developed: The more New Yorkers use private cars, the more transit traffic falls off and the more tangled street traffic congestion becomes. The result is frustration for both motorist and transit passenger.

There are some of the con-

Kheel Conducts Broad Study

In his survey of the transit-traffic problem, Mr. Kheel has met with representatives of the public, industry and labor, with civic groups and specialized organizations. He reported receiving hundreds of letters from riders with plans and suggestions.

Mr. Kheel found four main factors in the traffic crisis that have a significant bearing on mass transportation. These were:

¶Since the end of the war in 1945 there has been a tremendous shift from mass transit facilities to private cars. The public has not yet realized its significance.

¶The shift is continuing, and is, in fact, accelerating at a greater rate each year.

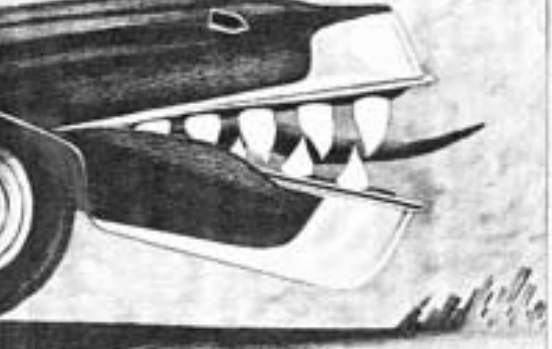
¶With hundreds of thousands of private automobiles in use—carrying one or two passengers—traffic congestion grows worse as the cars pour into the heart of the city.

¶This congestion slows bus schedules, hampers them, annoys passengers and diverts greater

NEW YORK

How To Stop Cars From Devouring the City

By Theodore Kheel



DAILY NEWS, FRIDA... — OCTOBER 13, 1968

Kheel Proposes Tolls On Major Highways

By RICHARD OLIVER

Theodore W. Kheel, head of Mayor Lindsay's committee to save the 20-cent fare, came up with another proposal yesterday to help mass transportation by imposing tolls—this time on all major parkways and expressways entering the city.

Kheel, already on record in support of tolls on the free Manhattan bridges and of increasing tolls on Hudson River crossings, said his committee is definitely considering the parkways and expressways toll plan.

Robert Moses
Wants new bridge and subway charges

Theodore Kheel
Backs user charges

NEW YORK