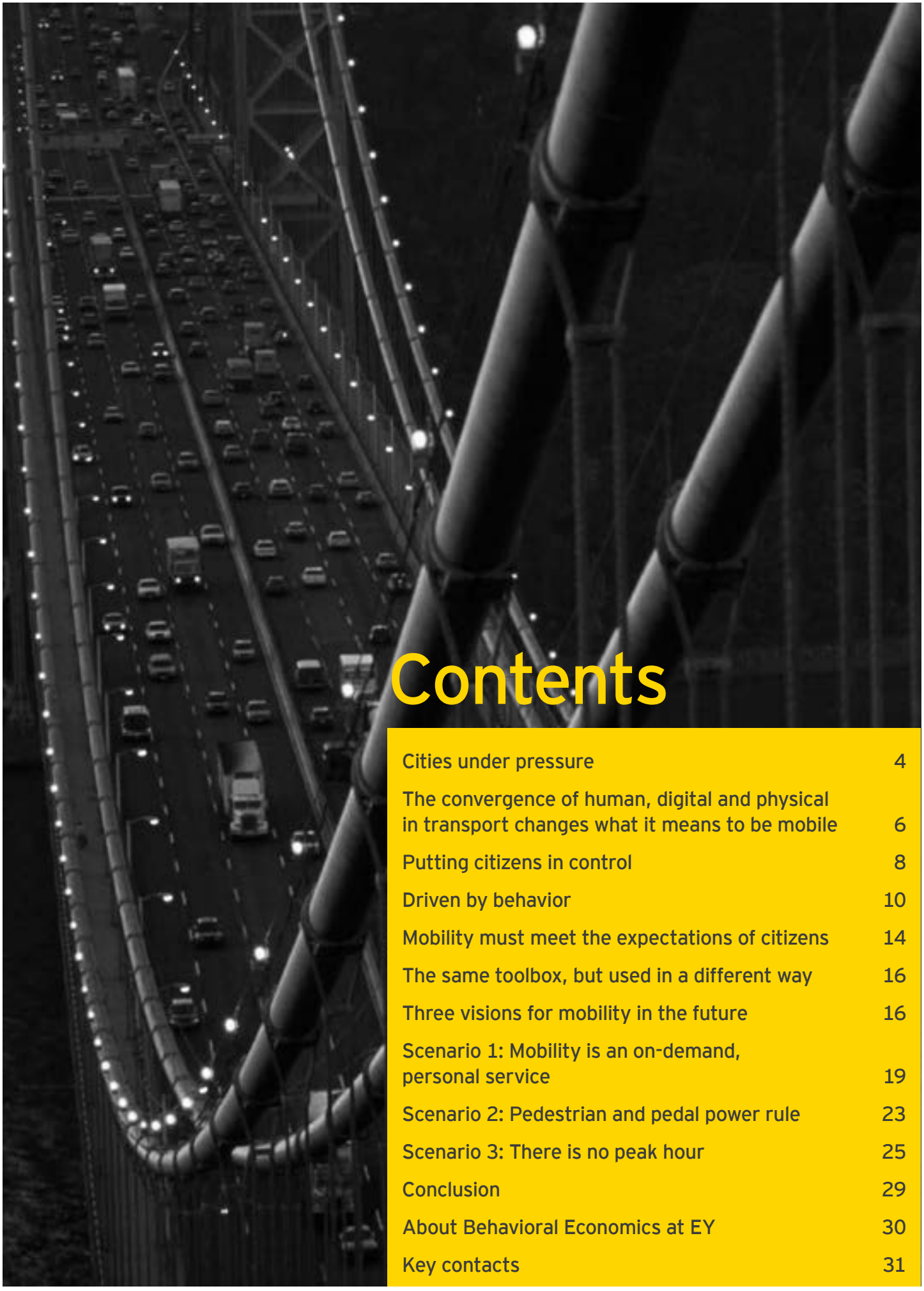
All change, please

How shifting passenger behavior can improve mobility in cities

EY
Building a better working world



Contents

Foreword

Cities are growing. Around the world, the population of established cities is increasing. And in the developing world, new and old cities alike are expanding at a rapid pace.

And citizens are changing. Armed with smartphones, they can find out and share information on any topic whenever they want.

These forces converge in the area of urban transport. Competition between cities for talent and investment is set to intensify. Slow, inefficient, unreliable transport networks damage businesses, tourism, quality of life and a city's reputation. So finding ways of developing an effective transport system that can cope with the growing demands of increasing populations is a key priority for city leaders around the world.

Understanding how people use transport networks is an important part of the solution. As people use mobile applications to assess their travel options in real-time and arrange shared taxi journeys, they are taking on more responsibility for their own mobility. How can transport planners gauge and harness this new behavior to help improve a transport system?

This paper addresses the challenge of urban mobility. Covering major cities in the US, UK, Australia, India and New Zealand, we interviewed policymakers[1] to better understand the behavioral forces driving mobility, and the policies that can improve it. We examine new thinking on what effective mobility will look like in the coming years, the impact that new disruptive technologies could have on the transport system, and show how innovative behavioral and microsimulation techniques can help inform policymaking.

We hope the policy alternatives presented in this study spark debate about transport policy planning and help leaders to develop more efficient transport systems that serve the needs of citizens and help to produce a better urban environment. In presenting a citizen-centric perspective to policy planning, our hope is alternative policies lead to more effective outcomes for citizens.

[1] Interviews conducted November 2015-January 2016.

Cities under pressure

"London sees mobility as essential to driving economic growth. We are developing the right transit offer for citizens of a global city."

Matthew Hudson
Head Business Development Fares & Ticketing, Transport for London

The growing economic power of cities and the accompanying demand for infrastructure is one of the themes that defines today's global economic and political landscape. The number and scale of cities continues to grow across the globe, driven by rapid urbanization in emerging markets and continued urbanization in mature markets. The United Nations estimates that 54% of the world's population currently live in cities, and that by 2050, this proportion will increase to 66%. It is clear that cities need effective infrastructure investment and sound planning if they are to remain competitive, resilient and good places in which to live and do business.[2]

Effective transport infrastructure is critical to a city's economic performance. But data suggests that many cities are lacking the required infrastructure and are not yet prepared to meet future demands on their transport systems. Congestion and widespread dissatisfaction among transport users suggest a clear opportunity to reform systems and policies. Crowding and underutilized transport systems also hint at a challenge that policymakers should address head-on: putting the user — the citizen — at the heart of the solution.

Riders, passengers and drivers should be the starting point for any decision-making process. With data and user feedback suggesting that traditional top-down transport planning modes are missing the mark, now is the time to reset the perspective for transport policymaking. Individuals and households are the real decision-makers. A thorough understanding of their behavior, and how policy can influence how they act, will be the cornerstone of effective transport policy.

How an individual moves through their city, and the quality of their access to economic and social opportunities, is ultimately what matters. Mobility shapes access to people, goods, information and services. The more efficient this access, the greater the economic benefits through economies of scale, agglomeration effects, networking gains and reduced opportunity costs.[3] This contributes to higher GDP and productivity.

Behavior is critical to mobility. New policies need to capture citizens' changing transit behavior and social norms.[4] For example, people expect technology to help give them more convenient and cheaper ways to get around their city. The proliferation of smartphones is an example of a key influence that should inform transport policy planning. This means a transport system that is not only integrated, but interactive. With individuals hyper-connected through social and digital channels, the same approach needs to be taken to policy around mobility. Citizens want intuitive, spontaneous interaction, and this extends to transportation.

[2] "Making sense of a world in motion — Megatrend: Urban World", *EY.com,* accessed April 2016, http://www.ey.com/GL/en/Issues/Business-environment/ey-megatrends-that-will-shape-our-future-5-urban-world.

[3] "Towards new urban mobility: the case of London and Berlin", *London School of Economics and Political Science, Innovation Center for Mobility and Societal Change,* 2015.

[4] Khademi, K & Timmermans, H, "*The Long-Term Effectiveness of A Rewards Scheme in Changing Daily Travel Choices,*" Procedia — Social & Behavioural Sciences, 2014.

"Cities are the engines of growth, and mobility is the wheel that takes it forward."

Amit Bhatt
Strategy Head – Integrated Urban Transport, World Research Institute Sustainable Cities

This report helps transport planners to utilize new and emerging mobility choices. It takes interactive personal mobility as the starting point, looking at individuals' behaviors to explore what it means to be mobile. Then it presents answers to the transport policy planning questions faced by major cities around the world. Using new behavioral modeling techniques (behavioral microsimulation), we test the very future state that transport policy is trying to achieve and review behavioral policy alternatives in order to sketch out what effective mobility actually means.

The convergence of human, digital and physical in transport changes what it means to be mobile

A new type of individual mobility, and the different behaviors associated with it, triggers the pressing need to change approaches to transport policy planning. Citizens' experience of mobility is evolving. And this is changing their relationship with transport infrastructure.

Step onto a street or subway platform in any major city and the influence of smartphones, social media and information flows is apparent. As users of transport systems, individuals everywhere are now connected to real-time information and transit alternatives (such as ridesharing, ridesourcing, taxi-hailing and multimodal transportation apps). For example, in 2014, smartphone travel applications were being used by over 70% of Londoners, while in Sydney more than 40 million travel information requests by smartphones are registered every month.[5]

Connectivity and information support users' travel decisions, giving them new ways of accessing the city. This is digitalization of consumption. It affects transport just as it does shopping. Technology and digital connectivity are enabling citizens to access new transport amenities from outside existing infrastructure. For example, some prefer shared, on-demand semi-private car use over more conventional taxi services. In fact, digital advances are bringing infrastructure to life in a new way, enabling citizens to discuss and plan their own journeys.

"Technology is enabling mobility more convenient than we have today. For example, location-based smartphones support very direct and convenient transport … Looking at apps, these make public transport more accessible, as you have more information … This transparency also helps to promote reliability."

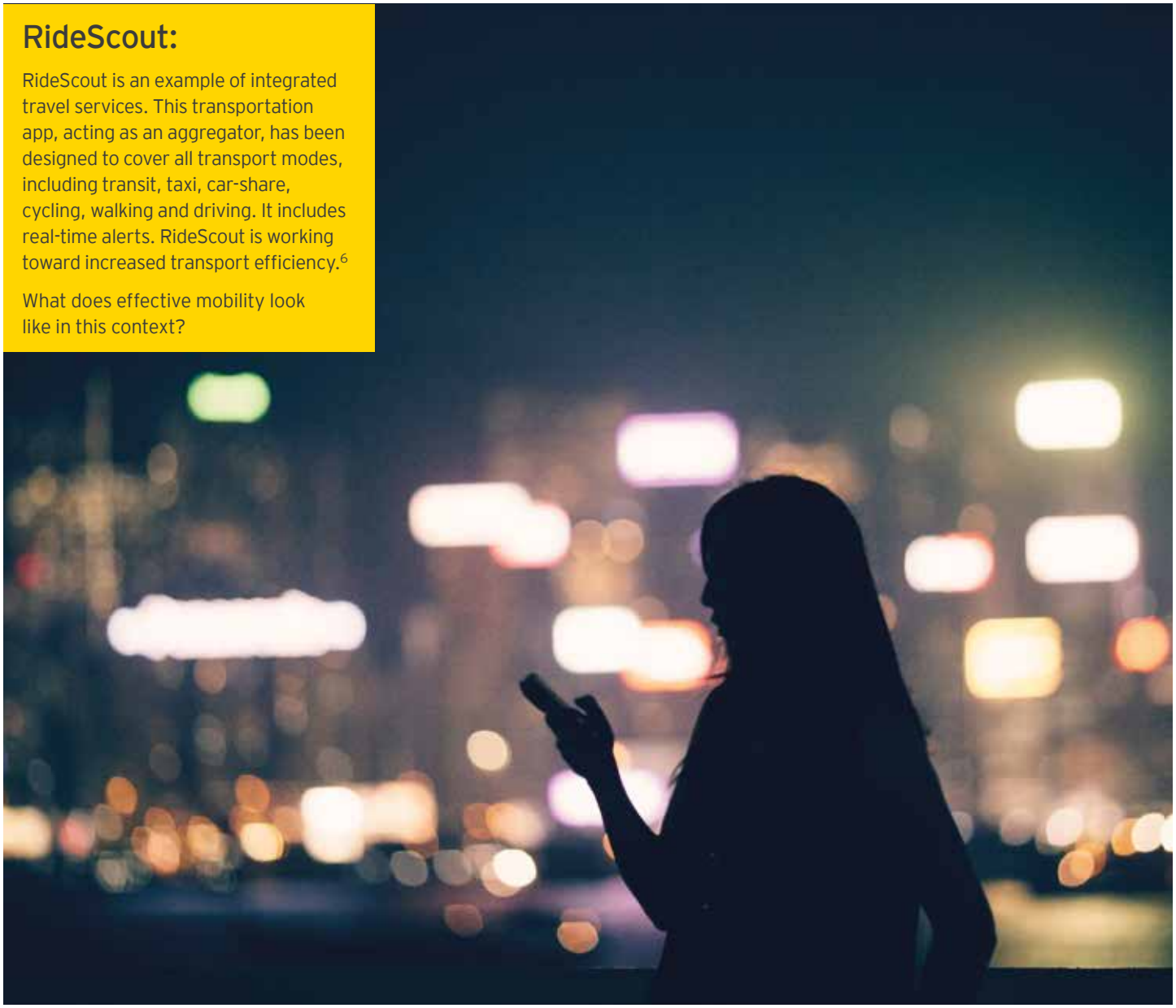
Joshua Schank
Chief Innovation Officer, Los Angeles County Metro

[5] Philipp Rode and Graham Floater, NCE Cities – paper 3, 'Accessibility in cities: transport and urban form, November 2014.

RideScout:

RideScout is an example of integrated travel services. This transportation app, acting as an aggregator, has been designed to cover all transport modes, including transit, taxi, car-share, cycling, walking and driving. It includes real-time alerts. RideScout is working toward increased transport efficiency.[6]

What does effective mobility look like in this context?



"The sharing economy is disrupting conventional transit planning [Uber; car share, etc.] as mobility becomes a utility or service."

Simon Warburton
Interim Transport Strategy Director,
Transport for Greater Manchester

[6] Interview with RideScout co-founder Joseph Kopser, 3 February 2014 accessible at: http://www.citylab.com/navigator/2014/02/super-useful-app-wants-change-how-we-move-through-cities/8274/.

Putting citizens in control

It is logical that, if transport planning is to be effective, policymakers should ensure that infrastructure and behavior work in concert. Households and individuals are the ultimate decision-makers. With more information, digital infrastructure and services on hand, they are in a position like never before to define the path forward for mobility in cities. Top-down planning risks missing this perspective. So, a renewed focus on the human being as the starting point for transport policy planning is important.

Significantly, this means more than just studying ridership. While ridership undoubtedly reflects individuals' behaviors and mobility choices, it does not properly represent the new "personal mobility." As a result, it fails to get to the heart of the issue of providing truly effective mobility. For example, a transit system could be very good at getting a large volume of passengers between fixed points. Ridership figures could capture one aspect of the system's uptake or success. However, they would not present the complete picture. The "first mile" and "last mile" problems are well-versed terms that highlight the imperfect nature of these systems as mobility solutions. Systems that lack fluidity, or end-to-end solutions, show that effective mobility, as an experience of "personal mobility," is not delivered.

What is needed instead is a policy planning focus on transit behaviors per person. Whereas ridership focuses squarely on the numerator — the number of riders — the emphasis should be on the denominator: the human being. How does this one person use modes of transport to get around their city? How do they access work and social opportunities? These behaviors per person ultimately contribute to their mobility, rather than the aggregate number of riders on one mode of transport.

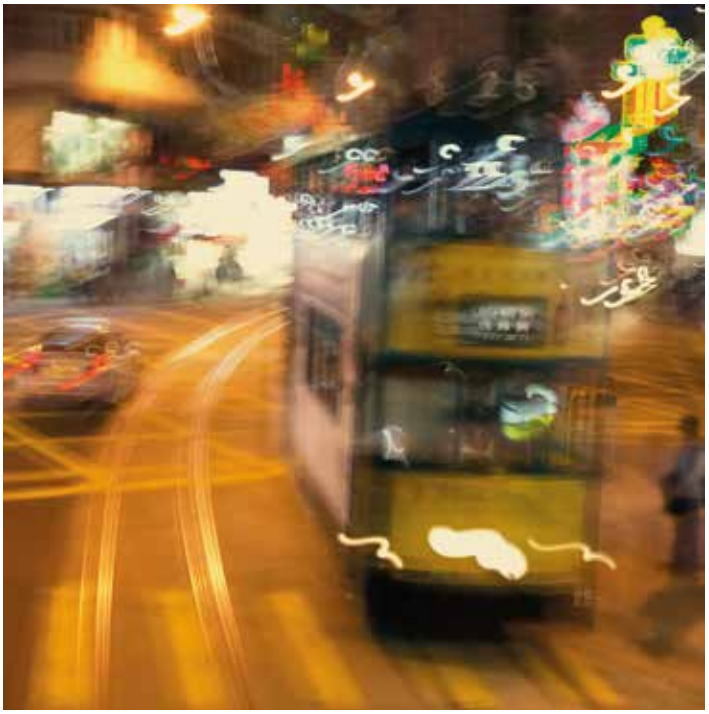
"[The citizen] is at the heart of all planning and upgrade considerations."

Matthew Hudson
Head Business Development Fares & Ticketing, Transport for London

"In Mumbai, people are using around 2 or 3 modes of transport while making their end-to-end journey. Integrated ticketing will certainly provide seamless travel for commuters and would save their time, which is one of the biggest factors affecting the mode choices of commuters in the city."

Ms Vijaya Lakshmi
Chief, Transport and Communication Division

Mumbai Metropolitan Region Development Authority (MMRDA)



Driven by behavior

"Behavioral changes play a more important role than technological changes in developing and implementing sustainable mobility practices. This includes interventions like attitudinal shifts towards public and non-motorized modes of transport."

Ravi Gadepalli
Program Manager (Transport),
Shakti Sustainable Energy Foundation,
New Delhi

If behaviors per person is the bellwether of effective mobility, transport policy planning needs to focus squarely on residents' mobility behaviors if it is to drive improvement. It is all the more important for policymakers to tune into behavioral patterns. As the dynamics of human, digital and physical infrastructure are transforming, mobility behavior is itself changing. For example, in London, new patterns in the usage of different transport modes are emerging. Public and non-motorized transport are clearly capturing an increasing share of transit activity, with the mobility share of driving down 12 percentage points from 1998–2013.

Residents' mobility behavior is changing in major cities: the case of London[7]

	Modal share in all trips, 1998 (%)	Modal share in all trips, 2013 (%)	Net change (%)	Share of all work trips, 2011 (%)
Public transport	33	45	12	54.4
Driving	45	33	-12	32.4
Walking	22	21	-1	9
Cycling	1	2	1	4.2

Such changes are important because they demonstrate that it is not only about behaviors, but also attitudes and the cognitive processes that drive human behavior. As the London example suggests, attitudes alter perceived opportunities for travel in cities. Large differences in the use of non-motorized transport, and public and private transit, hint at cultural and geographical factors, in addition to economic influences.

Of course, human behavior is complex and can be contradictory. It is important to remember this when considering mobility. For example, individuals and households may believe in environmental conservation, yet still prefer to use their car for routine journeys rather than a public transport alternative. Similarly, individuals may value the health benefits of walking or riding a bike, yet instead make use of ride-sourcing services for more of their trips. It is tapping into these socially-desirable behaviors and norms that offer important clues on effective behavioral-based reforms.

[7] Towards new urban mobility: the case of London and Berlin", *London School of Economics and Political Science, Innovation Center for Mobility and Societal Change,* 2015.

Behavioral economics for mobility

Behavioral economics (BE) is an approach that seeks to understand the factors that influence peoples' decisions, and use this understanding to design services that have better outcomes for citizens and society. One well-recognized policy framework, the EAST framework, spells out the key principles for behavioral interventions – easy, attractive, social and timely.[8]

Why use it for transport policy planning? First and foremost, to put the citizen at the center. BE is not a new concept. But applying it to more complex policy problems, such as mobility, is different. Where traditional interventions have proven inefficient, ineffective or too heavy-handed, a number of governments and other organizations have taken to "nudging" individuals to behave in ways that lead to better outcomes for themselves and society.

Follow the action: agreeing from the start that individual behaviors drive mobility, effective transport policy planning becomes a question of how to incentivize people to behave in a desirable way. How can they be nudged into acting in a way that is economically and socially desirable, such as taking the train instead driving, using a bike-share scheme or carpooling?

In a world of hyper-connectivity, this means tapping into the very digital and social channels that are having an ever greater influence over citizens' lives. The confluence of human, digital and physical factors means individuals are looking for an interactive experience – not just an integrated one – to explore their journey options. Transportation is becoming a conversation, not a transaction, for the user, and connecting with citizens on this level could be critical for amplifying socially desirable behaviors.

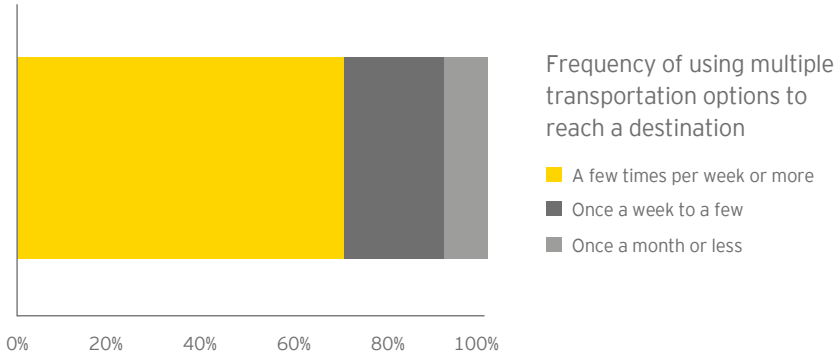
For citizens, integrated transport is the baseline for personal mobility, not the end game. The survey of millennials highlights that many respondents use multiple transportation options to reach a destination, and describe this as an increasing trend. The survey also shows that "my smartphone or another online planning tool recommended it" account for just 15% of total responses when asked the reason or situation where individuals use multiple transportation options to reach a destination.

[8] *The Behavioral Insights Team, Nesta & UK Cabinet,* "EAST – four simple ways to apply behavioral insights", 2015 "Millennials & Mobility".

"Mobility originates at the household level. Households make decisions based on affordability and access to schools. … In terms of solutions, there is embedded behavior that needs to shift if demand and capacity are going to come into line."

Shayam Kannan
Managing Director of Planning,
Washington Metro Transit Authority

Many people already use multiple transportation options to reach a destination (among % total)[9]



In fact, it's commonplace that an individual can interact with planning tools for their trip in a transit system, and design their own route. They can provide real-time feedback on traffic conditions, and on ride-sharing services. Significantly, the social nature of mobility extends well beyond the immediate task of planning and taking a journey. Individuals can share their preferences for different ride-sharing services, bike-share and other transit options using social media. Peer-to-peer payment apps also fuse together social and economic desirability with convenience and ease. These powerful channels add depth to an individual's mobility experience and hold an important key to nudging and sustaining behaviors now and in the future.

Mobility survey results highlight the importance of interactivity and social norms as influencers of individuals' behaviors. For example, the recent results from a US-based survey of people from the millennial[10] generation, people aged 15–35, found that "helps me feel more connected to my community and the area I reside in" was, for the majority of preferred transport modes, in the top three responses of perceived benefits.

These trends suggest that if a policy can appeal to social behaviors, or create a dialogue, it can influence social norms and make an important contribution to changing mobility behaviors. There are certainly examples where policymakers are using interactive platforms to engage users in tailoring and using transport systems. These cases hint at a coming trend where individuals not only direct their own mobility through an integrated service, but design transport services and shape demand across their peer group.

[9] Millennials & Mobility: Understanding the millennial mindset", *American Public Transportation Association,* 2013.

[10] "Millennials & Mobility: Understanding the millennial mindset", *American Public Transportation Association,* 2013.

"(A ride-sourcing provider such as) Uber adds to public transit experiences. It takes the anxiety away from public transit because Uber is a good back-up option before using private vehicles. Uber is simple, customer service-focused and cheaper."

Darren Davis
Principal Planner, Auckland Transport

Case study: making integrated transport interactive:

Connexxion is a transport provider in the Netherlands. It is planning to run a pilot with an app that gives bus passengers the opportunity to ask their next connecting bus to wait a bit longer, up to 4 minutes, if it's clear that the passenger will otherwise miss their connection. The driver of the connecting bus will receive the request and has the option to accept or decline the delay. This could be a solution in lesser populated areas where, for instance, regional routes run once an hour.[11]

The goal of truly interactive mobility sets the stage for transport policy planning in the coming years. The ability to leverage social norms and socially desirable behaviors for better mobility will become increasingly important as the degree of interactivity in an individual's day-to-day experience grows. Further digitization and automation of transport systems, the switch to electrification and even elements of virtualization suggest policymakers will need to be able to harness and shape behaviors around these technologies.

[11] AD, 'Reiziger regelt met app zelf of bus op hem wacht', 25 February 2016 accessible at: http://www.ad.nl/ad/nl/5597/Economie/article/detail/4251539/2016/02/25/Reiziger-regelt-met-app-zelf-of-bus-op-hem-wacht.dhtml.

Mobility must meet the expectations of citizens

"(Residents have) more diverse lives, different working styles … Current patterns of public transit are heavily focused on the peak commute that doesn't map how people operate … The system needs to be more flexible and provide more choice."

Darren Davis
Principal Planner, Auckland Transport

While not exhaustive, there are some emerging themes in mobility attitudes and travel patterns in some major cities that transport policy planners may want to give close attention. These provide clear insight on the types of social norms, and socially desirable behaviors, which policymakers can work to foster or discourage through behavioral policies.

An increasing propensity for an urban lifestyle, in a community with high accessibility to work and social opportunities, is important. With the revival of inner-city areas, city living is growing in appeal both for younger generations and retirees. Travel demands are changing accordingly, with increasing demand for public transit and multimodal travel.[12] Users are increasingly amenable to options other than driving. While these attitudes may be exemplified by young people, they are certainly part of a broader shift in preferences away from driving and toward alternative and mixed-mode forms of travel.[13]

Top five preferred modes of transportation: millennials (US cities)[14]

Mode	Mean preference rank (where 1= most preferred)
Driving a car	2.24
Walking	2.73
Subway, light rail, street car or trolley	4.09
Bus	4.34
Bicycle	4.34

Smart technologies and access to digital information are supporting these attitudes, rather than causes of the shift. The number of vehicle miles travelled by 16- to 34-year-old adults in the US was already trending down before smartphone technology took off. This decline has reportedly accelerated in recent years, reflecting technology-enabled transportation services, changing values and preferences as well as cost.[15]

[12] "Millennials & Mobility: Understanding the millennial mindset", *American Public Transportation Association,* 2013; Towards new urban mobility: the case of London and Berlin", *London School of Economics and Political Science, Innovation Center for Mobility and Societal Change,* 2015.

[13] "Statistical Dataset: Modal Comparisons (TSGB01)", *Gov.uk, https://www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons,* accessed April 2016.

[14] "Millennials & Mobility: Understanding the millennial mindset", American Public Transportation Association, 2013.

[15] "National Household Travel Survey as quoted in: Frontier Group and U.S. PIRG Education Fund, Transportation and the New Generation – Why Young People Are Driving Less and What it Means for Transportation Policy, April 2012.

The rider of the future:

- Is interconnected
- Expects seamless integration of transport options
- Has a flexible concept of "workplace" and "peak hour"
- Sees cycling and walking as viable options
- Takes an individualistic view of mobility

To best promote mobility, transport policy planning needs to make these trends in attitudes, and the associated preferences and behaviors of the future user, central to design. Current trends suggest the average future user will want to live in dense, community-oriented cities with short commutes, plentiful public transit, and non-motorized, customizable transport options.

"Younger generations are making different decisions ... Incoming and new household formations are taking a different approach to mobility, and this could have a material impact in the future."

Shayam Kannan
Managing Director of Planning,
Washington Metro Transit Authority

The same toolbox, but used in a different way

"We are looking to encourage market-driven service models like ridesharing car and bus services provided by aggregators … They can help to provide adequate mobility services in the city without adding significant infrastructural requirements."

Ravi Gadepalli
Program Manager (Transport),
Shakti Sustainable Energy Foundation,
New Delhi

Buses, cars, bikes and walking are still the foundations of transport and mobility. Transformation comes with the new ways of using existing infrastructure: the socio-technical transition. In other words, how does having real-time information affect mobility decisions? How will access to autonomous vehicles alter attitudes to travel? Where do new social norms, such as a reduced working week, fit in? How will disruptive developments, such as autonomous vehicles, fit into individuals' mobility patterns?

Three visions for mobility in the future

So, how can policymakers grasp socially desired behaviors, and harness digital, physical and human interactivity, to make progress toward the ultimate goal of more effective, personal mobility?

Below, we outline three potential outcomes for mobility for future residents in large cities. These are desirable future states for prosperous, competitive, sustainable urban centers. They reflect our conversations with policymakers in several major cities. In these examples, policy planners use new technologies (autonomous vehicles), leverage the changing social dialogue on mobility (to support non-motorized transit) and take advantage of digital connectivity (such as telecommuting and traffic information) to facilitate behavioral change.

Microsimulation is a good way of examine how new mobility choices affect behavior. It is the technique deployed here to test our scenarios.

Microsimulation:

Microsimulation predicts travel demand using behavioral modeling, citizens' activity patterns and their socioeconomic characteristics. This is a unique approach that can reproduce the complexity of an urban area and predict emerging behaviors.

Scenario 1:
Mobility is an on-demand, personal service

In this future state, mobility is a completely interactive experience. Digital social channels inform users' mobility decisions and are an important part of their journeys. At the same time, the increasingly blurred boundaries between the digital world, physical infrastructure and human activity mean that consumers have access to a customizable mobility service at their fingertips.

The challenge for policymakers is to convert attitudes, such as residents' acceptance of autonomous transport services and interest in ridesharing, into behaviors.

Case study:
Microsimulation — autonomous vehicles and ridesharing

This microsimulation case study examines one particular use of autonomous vehicles (AVs) and their predicted impact on congestion: ride sharing to and from school. A growing proportion of school students are being driven to and from school,[16] thus intensifying traffic and increasing congestion levels around school start and finish times. AVs offer the convenience of having children securely transported from their home directly to school and back again in the afternoon, relieving parents of this task. This may be particularly helpful for single, working and other time-poor parents, those who may not have access to a vehicle, and those without a license.

Ride-sharing services are already a reality, but for the purposes of transporting school-aged children, trust and confidence in the driver is important to parents. Parents may trust other parents who they know, but extending that trust to drivers of Uber-like services is an entirely different proposition. This suggests that transport policy can use enabling technologies — such as AVs, ridesharing and other apps — to drive growth in socially desirable behaviors and ease congestion.

Wide-scale adoption of ride sharing in AVs to and from school could have a complex effect on traffic conditions around school times. On one hand, parents drive less. On the other, additional ride-sharing vehicles would be put onto the road for the purpose of transporting students. Further, the choice of whether to use a ride-sharing vehicle or not depends on a number of factors,[17] including the perception of convenience and the maturity of the children in the shared vehicle.

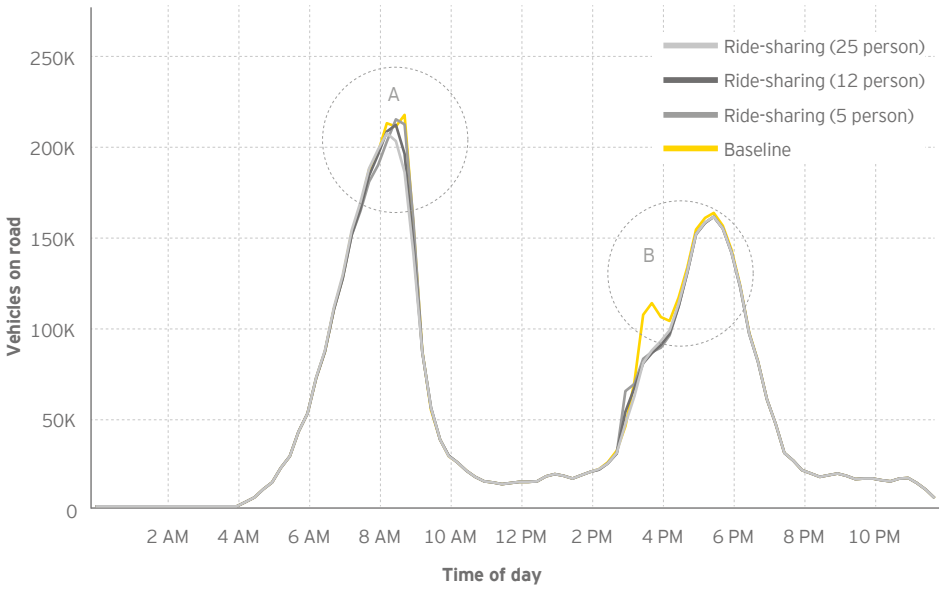
[16] McDonald, N. & Aalborg, A. (2009) *Why Do Parents Drive Their Children to School? Implications for Safe Routes to School Programs.* Journal of American Planning Association, Vol 75, No 3.

[17] McDonald, N. & Aalborg, A. (2009) *Why Do Parents Drive Their Children to School? Implications for Safe Routes to School Programs.* Journal of American Planning Association, Vol 75, No 3.

Here we examined the impact that wide-scale adoption of ride sharing to and from school would have on peak traffic in Sydney, Australia, to demonstrate the utility of the EY Synapse Simulait model, a behavioral microsimulation tool. Transportation behavior was simulated and compared for both a "baseline" case with no ride sharing and alternative cases with ride sharing of various vehicle capacities: small (5 persons); medium (12 persons); and large (25 persons). The Simulait model was enhanced to add cognitive decisions to determine if, and who, would use ride-sharing services.[18]

Figure 1 shows the results of the microsimulation. While the impact on the morning peak is relatively small (see A), it does reduce the total number of vehicles on the road by around 5%, especially for larger capacity vehicles. The afternoon school subpeak is greatly reduced (almost removing the subpeak entirely), because the majority of these trips are for the single purpose of collecting children from school (see B). The afternoon work subpeak is not significantly affected. In other words, there is a small, but significant, impact on mobility behaviors and consequently congestion.

Figure 1: Impact of ride sharing (number of vehicles on the road in Sydney)



[18] In all the ride-sharing scenarios, use of ride-sharing only targeted those households of children that were already driven to school by their parents in the baseline case, as being driven to school is a reasonable indicator of a likelihood of adopting ride-sharing. We note that other children, such those taking public transport, might also be amenable for ride-sharing, and this is an ideal approach to look more broadly at how AVs or other future transport disruptors may influence mode-choice for different individuals.

While the impact of ride sharing may seem relatively small in this simulation, it only examines the use of ride sharing for school traffic, which is only a relatively small portion of total traffic. If AVs were to be used in other areas and adopted across all personal transport, the impact could be much more significant. For example, research on the effects of AVs on a city network of road infrastructure found that the combination of AVs and reservation systems at intersections resulted in a 78% reduction in travel time.[19] Other research has found that AVs offer the potential for greater road capacity and network efficiency, reduced travel times, but significantly higher demand. The increase in demand, however, is more than offset by the increase in road capacity due to AV usage.[20]

To accentuate the positive impacts and reduce congestion, government could have a role in shaping and implementing behavioral policies that "nudge" consumers into the adoption of AVs. Our discussions with key government officials for this report identified several factors that impact mobility and that would either assist or hinder the use of public transport or AVs. These factors included frequency, punctuality, reliability and comfort. The uptake and use of AVs will also have knock-on benefits, such as reduced congestion (and therefore pollution), less vehicle wear and tear, improved efficiency of roads (and therefore time savings), and increased safety levels, leading to fewer vehicle accidents.

The key conclusions from the ride-sharing microsimulation are outlined in Figure 2. The results, and the potential broader application to traffic management, make ride-sharing, AVs and mobility on-demand services a worthy consideration by governments when deciding the direction of mobility policy.

Figure 2: Ride-sharing findings

Time	Morning	Afternoon	Evening
Outcome	Peak traffic demand decreases in the morning (~5% at the peak with the largest capacity ride-share vehicle). There are more children per vehicle than previously.	A previous peak in traffic demand at the end of school effectively disappears, removing – 24% of vehicles from the road. Trips by a parent with the sole purpose of picking up children are replaced by more efficient ride-sharing vehicles (carrying more children per vehicle).	There is no significant change to the early evening commute home from work peak.

[19] Boyles, S., Levin, M. & Patel, R. (2016) *Effects of Autonomous Vehicle Behaviour on Arterial and Freeway Networks.* Transportation Research Board Business Office, United States: Washington.

[20] Levin, M. (2015) ***Integrating Autonomous Vehicle Behavior into Planning Models.*** University of Texas at Austin.

"Uber and Lyft are now more like transit providers, and they are going to provide more convenient, effective services. There are also cheaper alternatives emerging … LA metro needs to partner with these entities, including through integrating their technology in the business model."

Joshua Schank
Chief Innovation Officer,
Los Angeles County Metro

Policy options: make on-demand mobility socially desirable and accessible

How can policymakers expand on the findings demonstrated in the microsimulation example above? This case study indicates that if transport policy planners can tap into socially desirable behaviors using digital enablers, they can have a potentially significant impact on mobility. Three major types of policy options could help them do this.[21]

First, influence transport demand

Real-time, interactive information platforms on public transport are critical to demand. Access to this information, the ability to edit it and the use of open data all support individuals' ability to view their journey's likely progress, monitor and control their mobility and reduce uncertainty. This makes individuals less reliant on heuristics, social norms and their inherent biases when deciding what to do. Given updated information, they are more likely to change their behavior and use public transport. In fact, real-time information has been shown to increase the perceived, and actual, reliability of public transit in several case studies.[22] Real-time, collaborative transit information is also the springboard not just for integration, but for interactivity across transit modes. For example, microtransit services, such as Bridj in some US cities, combine ride-hailing with public transit, involving both public and private entities, to encourage new, personal mobility behaviors. These examples show how policy, through technology, can enable desirable demand behaviors.

Second, stimulate new transport concepts

Policy can help consumers and businesses to change behavior toward different transport concepts that are socially desirable, such as car sharing and AVs. This includes government partnering with private sector players, including ride-sharing apps, to drive higher uptake. Integrated smart ticketing across modes and public and private providers would encourage citizens to take multimodal journeys. For example, the Infineon scheme in Dresden, Germany involves a ticket that can be used for all forms of public transport and technology platforms to support car sharing. The scheme has been very successful, with individual car use decreasing from 68% to 59%, use of public transport up by 49% and car pools increased by 35%.

Third, change public attitudes

Influencing community attitudes about mobility as a personalized service and promoting socially desirable transit behaviors are instrumental to uptake. Effective policy interventions include information campaigns.

[21] Korver, W. Huffelen, T. Becker, U. Schemien, V. Lindblom, H. Ericsson, E. & Malasek, J. (2015) Step by Step: *Learning from Implementing Behavioral Changes in Transport*. Technische University, Road and Bridge Research Institute, WSP and Goudappel Coffeng.

[22] Daniel Pulido and Diego Canales, 'Real-Time Passenger Information: Getting it Right', 19 November 2015 accessible at: http://www.worldbank.org/en/topic/transport/brief/connections-note-27.

Scenario 2:
Pedestrian and pedal power rule

For this future state, more residents are opting to live in inner-city locations and a decreasing proportion of people own cars. Non-motorized transport modes are predominant in city life. The bulk of a city's residents are active commuters, using non-motorized transport for a portion of their daily journeys.

To achieve the most effective outcome for mobility, the policy challenge is to enable residents to act on their preferences and aspirations for an active commute. This includes desires for a lower carbon footprint and for city living without owning a car. The twist on this challenge, in an environment of digital technology and hyper-connectivity, is to design policy that uses the socio-technical transition to enable behavior.

Policy options: appeal to social norms, make non-motorized transport choices easier

To help city residents become active commuters, transport policy planners can help make non-motorized transit the preferred option. Policies that use the interconnections between the digital world, physical infrastructure and human experience could be increasingly powerful ways to effect change.

First, incentivize changes in behavior

This can be through price, which incorporates the social costs of transport modes and thereby influences mobility decisions. Congestion pricing, or managed lanes – particularly if augmented by digitally-enabled, real-time pricing, information and illustration of cost – are one avenue. Other potential nudging policies include the concept of "free." For example, transport authorities could offer a free bus that brings commuters from outer city limits to the center. Passengers would then be required to disembark and walk to work or their specific location within the city. This would reduce the amount of cars and buses on the roads and encourage walking. These outcomes have positive external benefits for the environment and public health. In a recent campaign in Switzerland, several cities required residents to give their car keys to officials in exchange for a free electric bike and free use of the local car-sharing scheme. Transit apps, including for bike or car sharing, as well as social platforms or open-source app development, could certainly enhance incentives for behavioral change.

"In Mumbai, we are unable to cope with mass transportation demand. Car population is continuously increasing. We should aim to achieve 80% travel by a mass transport system. We should also aim for walk to work trips."

Mr. Soma Vijayakumar
Chief General Manager (T & A) – City And Industrial Development Corporation Of Maharashtra Limited (CIDCO), Navi-Mumbai

"How to make transit users truly multimodal is a key policy question."

Shayam Kannan
Managing Director of Planning,
Washington Metro Transit Authority

Policymakers can also use the loss aversion principle to encourage people to be active commuters. Consumers could pay more, or lose some kind of benefit, when they use motorized, or private, methods of transport. A higher car registration fee could be charged to people who drive more miles over the year or who use fuel-heavy vehicles. The use of social platforms and real-time information delivered through apps could work to accelerate change.

Second, encourage people to complete their journey by walking or cycling

Bike-sharing systems already encourage people to use pedal power to finish the last leg of their journey. More could be done to increase the use of walking and cycling to complete journeys, in particular by making the transit experience completely integrated, and also interactive, for residents. A bus ticket could include the use of a bicycle for the last segment of a person's journey. Furthermore, such as scheme could be integrated into a digital social platform, which could include crowd-sourced transit routes, health tracking and other functionality. The "Optimizing Use" project in the Netherlands highlights the important role of choice architecture, with an increase in secure cycle parking at stations an alternative incentive.

Third, change attitudes to non-motorized transit

Digital social channels can amplify positive behaviors and attitudes to walking and cycling, and also discourage car use. The Swedish cities of Malmo and Lund ran a campaign to highlight that car trips can often be quite short and unnecessary and that other, more socially beneficial, methods of travel offer better alternatives. The project was considered successful, with 15% of those people who saw the campaign stating they had decreased their car use as a result.[23]

[23] Korver, W. Huffelen, T. Becker, U. Schemien, V. Lindblom, H. Ericsson, E. & Malasek, J. (2015) Step by *Step: Learning from Implementing Behavioral Changes in Transport*. Technische University, Road and Bridge Research Institute, WSP and Goudappel Coffeng.

Scenario 3:
There is no peak hour

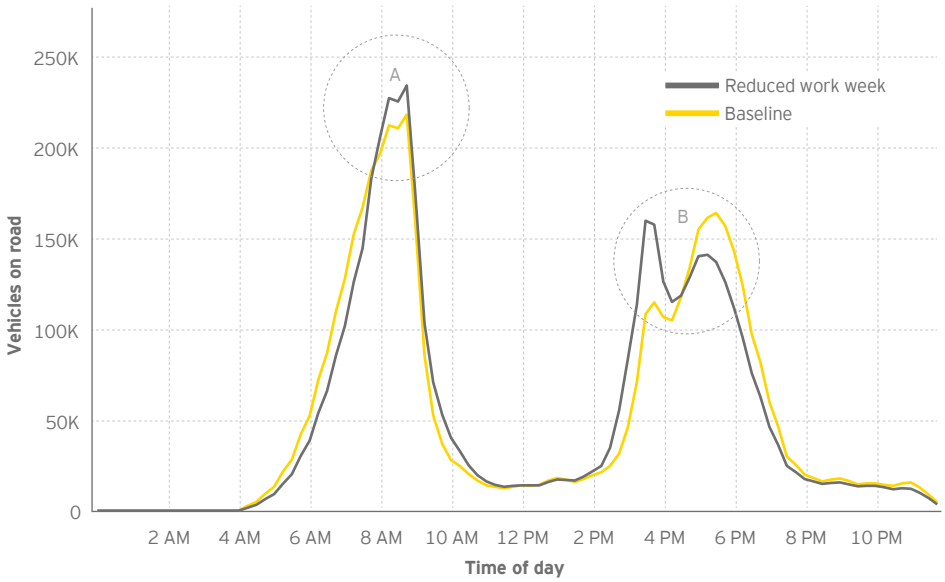
In this vision of the future, worsening congestion is a thing of the past. Residents spread their usage of the transit network. With many people telecommuting, and non-work trips comprising a higher proportion of travel, residents have flexible transit times.

To achieve this outcome, engaging residents with appropriate incentives and penalties so that they adapt their behavior is the focus for policy. There are many ways behavioral incentives could "shift the peak." Framing what a "commute of the future" could look like – the length of the working week, how people use telecommuting and plan for social gatherings – is the first step. Governments can then use digital technologies to bring it to life, through interactive platforms and effective use of real-time information.

Case study: Microsimulation – smoothing the peak

For there to be no peak hour, and for governments to introduce behavioral incentives to get there, transport policy planners need a clear vision of what the new transit week could look like. Digital technologies enable many permutations of work-from-home schemes and flexible commute times. It is important to test the target "future state" that these interventions are aiming to achieve. To look at shifting peak traffic demand in a major urban center, we used the EY Synapse Simulait model to consider the potential impact in Sydney, Australia, of the adoption of a 30-hour working week. The reduced working week could be achieved through four full-days or a six-hour working day. Figure 3 shows the results of the microsimulation for a Tuesday, for both the standard duration working week model (yellow) and the 30-hour working week model (dark gray).

Figure 3: Impact of a reduced working week – vehicles on road in Sydney for a Tuesday



The figure shows that the main impact is to reverse the dominance of the two afternoon subpeaks. The afternoon "school" subpeak increases and the evening "work" subpeak decreases (see B). The change is quite pronounced and is a fundamental shift in commuting patterns. This behavior is consistent, with a significant proportion of people adopting a six-hour working day so they can leave work earlier and pick up their children from school. There is also a slight change to the morning peak (see A). The time of the tip of the peak remains unaltered, but the traffic in the lead-up period has reduced slightly, due to a proportion of workers choosing to start work later.

Figure 5: Thirty-hour working week findings

Rush hour: Rush hour moves from early evening to mid-afternoon to coincide with the end of school. Parents align work times in order to collect children from school	**Peak hour:** Peak traffic demand decreases in the early evening (~17% at 5:30pm). People leave earlier than previously to collect children from school
Travel routine: People leave home for work later in the morning. The morning ramp-up in peak traffic demand is ~20 minutes later than previously	**Peak days:** Peak traffic demand increases in the morning (~7% at 8:30 a.m. on Tuesdays, the least likely day a person will take off). School and work start times constrain how late people leave home. For Mondays and Fridays, the most likely days a person will take off, there is no net increase in the morning peak.

Ultimately, the key conclusions of the microsimulation run counter to the desired impacts. Government may introduce a reduced working week with the intention of reducing the number of residents traveling at the same time and easing congestion. But the case study shows that this is not the effect — unless, of course, additional practices and policies are put in place to distribute and manage transport demand. In fact, in some instances, the peak is compressed and worsened.

The overall impact on peak-hour traffic will depend on what proportion of the full-time workforce will adapt to a 30-hour working week and how it will affect their behavior. Factors that influence the uptake and response to this policy include the type of occupation and industry a person works in, as well as their personal circumstances. Behaviors can surprise and there is a clear role for behavioral economics in understanding these nuances and nudging residents' decisions in line with the desired response. Context is also critical for this future state. Social norms and socially desired behaviors influence attitudes to a shorter working week. This is evident in the varying results and degrees of success that the introduction of flexible working arrangements has had in cities around the world.

This case study also indicates that an entirely different policy or outcome may be what is required to achieve the government's ultimate objective. For example, the results suggest that, to shift the peak, we don't need to address working practices, but rather focus on other drivers of commuter behavior, such as the school run.

Policy options: influence commuting patterns through price, information and shared incentives

Nudging consumers to change car use can come in several major forms. All of these interventions can use the close connection between digital, infrastructure and the individual to tap into behavioral drivers and have a real impact on mobility.

First, introduce differential pricing

Varying price according to the time of day and other factors can nudge residents to change the time that they commute to and from work. Demand-price parking is a mechanism that already works effectively, with higher prices on busy streets and variable rates during the day.[24] Differential pricing can encourage consumers to use these parking spots at quieter times of the day, shifting their driving patterns to non-peak times. However, a large-scale shift in behavior is dependent on citizens' ability to change their daily activities. In a similar vein, temporal road pricing, public transport fare options and road and zone tolling can be used to nudge consumers into shifting their daily routine and habits. This could include not only peak pricing or tolling in certain zones or roads, but also fare-free services. Examples include Melbourne's Early Bird

[24] Rebecca Beitch, 'Cities Try $6, $8 Hourly Parking to Cut Congestion, Pollution', 3 February 2016 accessible at: http://www.routefifty.com/2016/02/cities-hourly-parking-congestion-pollution/125653/?oref=rf-today-nl.

scheme — under which rail passengers get reduced prices if their journey is completed before 7 a.m. The scheme resulted in 23% of users bringing forward their trips from the morning peak.[25] The success of such schemes can be amplified through digital channels, more sophisticated use of real-time information, integration with information on public transit, socially-driven payment apps and fare credit arrangements.

Second, incentivize "peak avoidance"

As an alternative to congestion charging, positive incentives can also change behavior. These include monetary rewards (such as cash or credit toward particular stores) or in-kind rewards (such as the use of specific lanes, exemption from toll roads or guaranteed parking). A rush-hour avoidance project in Rotterdam offers an example of effective practice. The three-year project aimed to change travel behavior by offering monetary rewards, of €3–€5, to commuters who avoided peak time. It reduced the number of vehicles by more than 7%. The trial also showed that a major incentive to change behavior can have a long-term impact. Two months after the end of the trial, 54% of participants continued to travel at off-peak times.[26] Again, amplifying such schemes through social digital platforms can have a significant impact. Interactive use of real-time data would also bring these schemes to life. In a trial in Los Angeles, an incentive-based active demand management system predicted future traffic conditions and provided car commuters with multiple departure times and route choices. Each of these choices were assigned a points value with higher points (and thus better rewards) available for those who changed their behavior and chose to travel off-peak or on less congested roads. The trial lasted for 10 weeks. Significant behavioral change was observed, with a 20% travel time saving for those who altered their behavior.[27]

Third, provide residents with more information and alternatives

The provision of real-time data through digital platforms can be powerful when combined with differential pricing. Support for crowd-sourced information, apps and greater transparency will be powerful, standalone tools that help to smooth the peak.

[25] Evan Gwee and Graham Currie, Review of Time-Based Public Transport Fare Pricing in: Journeys, September 2013

[26] Korver, W. Huffelen, T. Becker, U. Schemien, V. Lindblom, H. Ericsson, E. & Malasek, J. (2015) Step by Step: *Learning from Implementing Behavioral Changes in Transport.* Technische University, Road and Bridge Research Institute, WSP and Goudappel Coffeng.

[27] Hu, X. Chiu, Y. Delgado, S. Zhu, L. Luo, R. Hoffer, P. & Byeon, S. (2014) *Behavior Insights for an Incentive-Based Active Demand Management Platform.* Transportation Research Board. USA.

Conclusion

As urban areas grow, developing more effective mobility is becoming an urgent transport policy planning priority for city leaders around the world. With digital, physical and human factors converging, the challenge is to drive personal, interactive mobility for residents. Behaviors are determining mobility and suggest a break with the past for transport policy planning.

A future defined by effective mobility could be one with no peak hour, where active commuters dominate and where getting around is a personal, on-demand service. The twist on this challenge, in an environment of digital technology and hyper-connectivity, is to design policy that uses the socio-technical transition to enable behavior. Microsimulation and behavioral policy alternatives offer important ways for looking at these future states and providing potential solutions for cities. Municipalities can consider a wider, and more nuanced, range of policies designed to nudge citizens out of their cars and onto their bikes.

Balance is key. There is an important distinction between the enablement of better mobility and the creation of a complex environment that simply adds costs and nudges people the wrong way. The complexity involved in understanding human responses is why experimentation and adequate planning and designing is so critical to the success of transport policy. There is no single winning policy measure. Instead, careful development and implementation of a range of policies is required. The keys to better mobility are in the hands of transport users. Policymakers can help them to turn the lock.

About behavioral economics at EY

Effective mobility in cities is a critical enabler for productivity, economic growth and sustainability. At EY, we have capabilities across transport policy planning, behavioral economics and microsimulation, and economic development, in diverse settings. EY is the most globally integrated professional services organization — in our mind-set, actions and structure. We are building a practice that will support innovative thinking on transport policy planning and the efficient, effective and economic delivery of mobility services around the world.

Behavioral modeling and advanced analytics

Advice to support social policy and demand management and predicting the impact of future disruption

EY global **Synapse Simulait** microsimulation modeling capability assists organizations to better predict human behavior of populations in rapidly changing environments, and understand the future impact of social policy interventions and disruptive technologies.

Behavioral economics advisory

Behavioral change programs and services to realize improved and sustainable social, safety and environmental outcomes

We draw on behavioral insights based on economics, psychology and social anthropology theory and practice to understand how people make decisions and to design interventions, or "nudges" for decision-markers. We analyze the nonrational elements of economic decisions made by individuals and institutions, including running trials and testing behavioral changes, which allows us to provide innovative approaches to problems that help our clients more effectively design and implement policies.

Smart transport

Advice and support on developing and providing multimodal, multi-operator urban transport recommendations

Smart transport infrastructure is a critical enabler for economic growth and competitiveness and should be the backbone of any effective smart city strategy. We work with the public and private sector across the whole project life cycle, from planning and procurement to provide, operations and exit, to provide the largest and most complex smart transport projects.

Economic development

Advice and provision of investment strategies, growth projects and innovation drivers

We advise organizations and local and central governments on innovation, growth, and entrepreneurism to help them plan for the future and provide sustainable economic development in an increasingly competitive environment. Our four key services are competitiveness and attractiveness strategies; sector studies and standardising; organization performance and governance; and urban projects, feasibility and financing.

Asset information and digital

Driving value from data within the built environment and across infrastructure

Digital information is transforming the built environment, providing substantial financial, economic, social, safety and performance benefits. Infrastructure Intelligence support significant outcomes for citizens, transport, construction and infrastructure management organizations. This is done through better generation, collection, management and exploitation of information to support technology help transformation.

Innovative funding and finance

Financial advice to cities on the design, build, finance and operation of infrastructure

We provide robust financial advice to cities on major capital infrastructure projects. This includes capital transformation — valuations and business modeling, lead advisory, transaction integration, restructuring; transaction support; and transaction tax.

Key contacts

George Atalla
EY Global Government &
Public Sector Leader
george.atalla@ey.com

Bill Banks
EY Global Infrastructure Leader
bill.banks@au.ey.com

Rebecca Hiscock-Croft
Senior Strategic Analyst, Global
Government and Public Sector
Ernst & Young LLP
rebecca.hiscockcroft@ey.com

Tony Canavan
EY Transport Leader,
Government and Public Sector
tony.canavan @au.ey.com

Oliver Jones
EY Oceania Leader, Policy, Economics
and Regulation
oliver.jones@au.ey.com

Abhaya Agarwal
Partner, Infrastructure and PPP
Ernst & Young LLP
abhaya.agarwal@in.ey.com

Tom Rousakis
Senior Managing Director,
Ernst & Young Infrastructure Advisors, LLC
tom.rousakis@ey.com

Rob Krizman
Partner, Advisory Analytics &
Enterprise Intelligence, EYC3
rob.krizman@ey.com

Lauren Jewell
Senior Manager, Infrastructure Advisory
Ernst & Young Transaction Advisory
Services Ltd
lauren.jewell@nz.ey.com

Tamara Wheatley
Manager, Economics Advisory Services
Ernst & Young LLP
tamara.wheatley@ca.ey.com

EY | Assurance | Tax | Transactions | Advisory

About EY
EY is a global leader in assurance, tax, transaction and advisory services. The insights and quality services we deliver help build trust and confidence in the capital markets and in economies the world over. We develop outstanding leaders who team to deliver on our promises to all of our stakeholders. In so doing, we play a critical role in building a better working world for our people, for our clients and for our communities.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients. For more information about our organization, please visit ey.com. How EY's Global Government & Public Sector can help your organization.

Around the world, governments and not-for-profit organizations are continually seeking innovative answers to complex challenges. They are striving to provide better services at lower costs and to create sustainable economic development, a safe environment, more transparency and increased accountability. EY combines private sector leading practices with an understanding of the public sector's diverse needs, focusing on building organizations' capabilities to deliver improved public services. Drawing on many years of experience, we can work with you to help strengthen your organization and achieve lasting improvements. Our Global Government & Public Sector brings together teams of highly skilled professionals from our assurance, tax, transaction and advisory services. We are inspired by a deep commitment to help you meet your goals and enhance public value, for today and tomorrow.

EYG no. 01855-164Gbl

BMC Agency
GA 0000_06702

ED None.

In line with EY's commitment to minimize its impact on the environment, this document has been printed on paper with a high recycled content.

ey.com/government
@EY_GovtPublic

@EY_GovtPublic