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INDUCED DEMAND'S EFFECT ON FREEWAY EXPANSION

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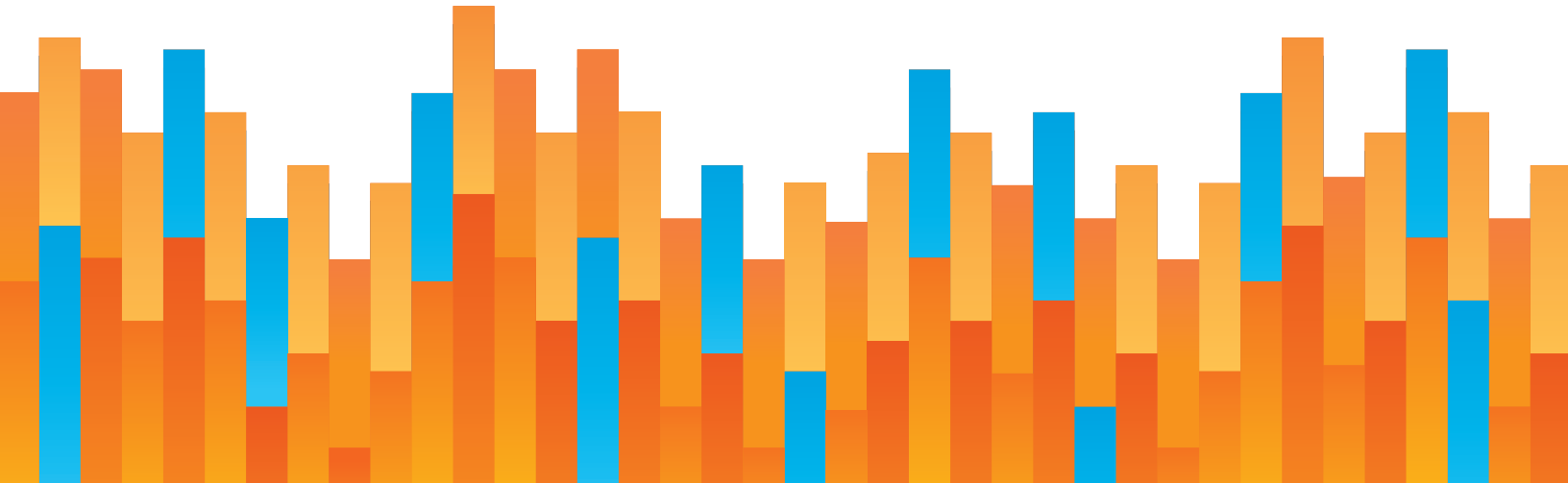

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INTRODUCTION

As auto travel and the economy recover from the COVID-19-related slowdown, transportation planners and engineers will need to decide how much new roadway capacity to build. In the post-World War II years, the U.S. built thousands of miles of highways—40,000 miles of Interstate highway alone between 1956 and 1980.[1] However, the country has added significantly fewer miles over the past 40 years.[2]

One reason that highway construction slowed is the growing challenge of building roadways, particularly in urban areas. Starting in the late 1960s, community groups began protesting the construction of Interstate highways, some of which divided neighborhoods.[3] These protests led state departments of transportation (DOTs) to cancel numerous freeway projects and, along with the growing concern about the environment, gave power to anti-roadway and "smart growth" groups.

Over time, groups opposed to highways have become more sophisticated as social justice groups, residents opposed to development (also known as Not In My Backyard, or NIMBYs),

1 Wendell Cox and Jean Love, "40 Years of the U.S. Interstate Highway System: An Analysis The Best Investment A Nation Ever Made," *publicpurpose.com*, The Public Purpose, June 1996. http://www.publicpurpose.com/freeway1.htm (3 Nov 2021).

2 "U.S. Vehicle Miles," Bureau of Transportation Statistics, bts.gov, 2021. https://www.bts.gov/content/us-vehicle-miles (3 Nov. 2021).

3 Suzanne Gamboa et. al, "Bulldozed and Bisected: Highway Construction Built a Legacy of Inequality," *nbcnews.com*, NBC News, 18 June 2021. https://www.nbcnews.com/specials/america-highways-inequality/ (5 November 2021).

and opportunistic politicians have joined forces.[4] One justification these groups have for opposing new highway capacity is a concept called induced demand. Induced demand is the notion that when you add new capacity to a congested highway, that improvement reduces congestion, which then leads to more people opting to travel and the return of congestion. While induced demand exists in some circumstances, smart growth groups often exaggerate the magnitude of induced demand or claim it exists when some other factor, such as rapid population growth, is causing the congestion. They also fail to appreciate how, even if congestion returns, a highway can accommodate more travelers after it is widened. The purpose of transportation systems is not to reduce congestion, but to provide mobility.

“Induced demand is the notion that when you add new capacity to a congested highway, that improvement reduces congestion, which then leads to more people opting to travel and the return of congestion.”

This brief begins by providing a history of induced demand. Then, it examines different scenarios to see when induced demand is an issue and when it is not and how that affects the benefits of a capacity expansion. Next, this brief explores how current and future travel patterns are likely to lessen induced demand. After that, it highlights the advantages of induced demand and compares how society views induced demand of highways compared with induced demand in other areas. Finally, this brief provides some policy suggestions on how to reduce induced demand.

[4] Garrett Dash Nelson, “How NIMBYs Made Back Yard Mean Entire Neighborhood,” *Bloomberg.com*, Bloomberg CityLab, 6 Feb. 2019. https://www.bloomberg.com/news/articles/2019-02-06/where-does-a-nimby-s-back-yard-begin-and-end, (20 Dec. 2021). “Stop Highway Expansion,” *sierraclub.org*, Sierra Club Maryland Chapter, 2021. https://www.sierraclub.org/maryland/stop-highway-expansion (20 Dec. 2021). Colleen Martin, “Elrich Pens Opposition Letter Before I-270 Toll Lane Vote Aug. 11,” *patch.com* Patch, 10 Aug. 2021. https://patch.com/maryland/silverspring/elrich-pens-opposition-letter-i-270-toll-lane-vote-aug-11 (20 Dec. 2021).

PART 2

HISTORY OF INDUCED DEMAND

The concept of induced demand began with the research of the late economist Anthony Downs.[5] In 1982, Downs released his landmark book, *Stuck in Traffic*, which argued that new capacity may not relieve traffic congestion due to the Triple Convergence Theory. Under the Theory, once new capacity is added, three types of travelers will switch to using it. The first traveler changes his *route* from a different highway to the new capacity due to the travel time-savings. The second traveler switches the *time* of his trip since the highway is less congested during his preferred travel time. The third traveler switches the *mode* of his trip from transit, bicycling, or walking to driving, because, with the new capacity, driving provides a more convenient trip. These three types (route, time, and mode) result in the triple convergence of travelers using the new capacity because it is more convenient than their previous travel option.

New capacity may induce travel in one additional group—folks who otherwise would have stayed at home or not traveled as far. For example, instead of eating at home, travelers go out to eat at a restaurant. Instead of watching a baseball game on television, fans attend the game in person. Instead of shopping at a nearby store they travel farther to take

[5] Anthony Downs, "Traffic: Why It's Getting Worse, What Government Can Do," Brookings Institute, 1 January 2004. https://www.brookings.edu/research/traffic-why-its-getting-worse-what-government-can-do/ (5 Nov. 2021).

advantage of greater selection or lower prices at a more distant establishment. These new travelers are induced to make the additional trip due to the improvement in the roadway.

In the mid-1990s, about 10 years after Downs published his book, University of California at Berkeley Professor Mark Hansen wanted to quantify how induced demand affected fast-growing (at the time) California. Hansen looked at urban counties in California in the 1970s and 1980s and found that, in metro areas, for every 1% increase in new roadway capacity there is a 0.9% increase in demand.[6]

However, Hansen's study had significant limitations.[7] It conflated cause and effect, assuming more capacity was leading to more demand when much of the time it was more demand leading to capacity. Further, it examined highway corridors as individual units instead of studying a county's highway system as one unit. Since travelers may switch from one highway to another it is critical to study the entire highway system. Finally, the study did not examine whether or not the speed of travel increased. Some new capacity is more valuable than others. Simply examining the new capacity by itself is not sufficient.

To his credit, Hansen worked with other researchers to try to fine-tune his induced demand results.[8] Neither Downs nor Hansen argued that triple convergence and induced demand meant that a roadway should not be widened or new capacity added. Rather, they argued that the theories suggest that those roadways may become congested again in the not-so-distant future. In fact, according to Downs, traffic congestion wasn't necessarily a problem but was the logical result of people's decisions.[9] His policy suggestion was to price roadways or learn to enjoy being stuck in traffic.

6 Mark Hansen, "Do Highways Generate Traffic?" *Access Magazine*, Fall 1995. https://www.accessmagazine.org/fall-1995/do-new-highways-generate-traffic/ (9 Nov. 2021).

7 Robert Cervero, "Are Inducing Travel Studies Inducing Bad Investments?" *Access Magazine*, Spring 2003, https://www.accessmagazine.org/spring-2003/induced-travel-studies-inducing-bad-investments/ (9 Nov. 2021).

8 Robert Cervero and Mark Hansen, "Induced Travel Demand and Induced Road Investment," *Journal of Transportation Economics and Policy*, (2002). 469-490. *JSTOR*, https://www.jstor.org/stable/20053915 (5 October 2021).

9 Matt Schudel, "Anthony Downs, Who Viewed Politics and Traffic Through Lens of Economics, Dies at 90," *The Washington Post*, 27 October 2011, washingtonpost.com, https://www.washingtonpost.com/local/obituaries/anthony-downs-dead/2021/10/27/ebff5d5a-3679-11ec-8be3-e14aaacfa8ac_story.html (8 Nov. 2021).

> *In fact, according to Downs, traffic congestion wasn't necessarily a problem but was the logical result of people's decisions. His policy suggestion was to price roadways or learn to enjoy being stuck in traffic.*

Unfortunately, many were not interested in Downs' and Hansen's policy recommendation. And they were not interested in the benefits of new highway capacity.[10] Rather, they spun Hansen's original study, which he admitted had limitations, to argue that since some new capacity will become congested in the future, and that congestion relief is the only benefit of new capacity, no new highway capacity should ever be added.[11]

In fact, smart growth interests claimed that induced demand existed in so many places where it did not that, between 2002 and 2004, a cadre of academics wrote studies rebutting many of the false cases of induced demand. Robert Cervero, who worked with Hansen on one of his follow-up studies, wrote a series of articles and studies debunking false claims of induced demand.[12]

Cervero used path analysis (the route commuters use on their home to work trips) to show that a 1% increase in capacity led to a 0.4% increase in demand, not the 0.9% increase in demand that Hansen's earlier study claimed.[13]

Cervero is now retired, but the flood of questionable induced demand claims has only grown. Recent articles in *CityLab*, *Politico*, and *The Washington Post* claimed that, due to

10 Kea Wilson, "America is Spending Billions Just to Make Traffic Worse," *usa.streetsblog.org*, StreetsblogUSA, 11 Mar 2020, https://usa.streetsblog.org/2020/03/11/america-is-spending-billions-just-to-make-traffic-worse/, (17 Nov. 2021).

11 Joe Cortright, "Wider Freeways Don't Reduce Congestion," *cityobservatory.org*, CityCommentary, 3 Apr. 2019, https://cityobservatory.org/rose_quarter_congestion/ (17 Nov. 2021).

12 Robert Cervero, "Induced Demand: An Urban and Metropolitan Perspective," *epa.gov, fhwa.gov, enotrans.org,* U.S. Environmental Protection Agency, Federal Highway Administration, and Eno Transportation Foundation, March 2001, https://escholarship.org/uc/item/5pj337gw (8 Nov 2021).

13 Cervero, "Are Inducing Travel Studies Inducing Bad Investments?"

induced demand, widening Interstate highways would do nothing to solve congestion.[14] Recently, several smart growth groups introduced an induced demand calculator that assumes induced demand is the same for all roadways in a classification (Interstates, major arterials, etc.).[15] The calculator does not differentiate between general purpose lanes, high occupancy vehicle lanes, and toll lanes, despite research showing significant differences in the rate of induced demand for each roadway type. The calculator warns users that it is not designed for individual projects, but then uses an individual project as an example.

Transportation agencies continue to research the effects of induced demand. Recently, the California Department of Transportation (CalTrans) tasked an expert panel with identifying the rate of induced travel.[16] To simplify its work the panel focused on managed lanes only. The panel was created to help policymakers understand travel patterns as the state shifts from using level of service to vehicle miles traveled to measure transportation impacts.[17] As more states contemplate these shifts, a better understanding of induced demand is crucial.

> *... since the outbreak of COVID-19, travel patterns have changed.*

[14] David Zipper, "The Unstoppable Appeal of Highway Expansion," *bloomberg.com*, Bloomberg CityLab,28 September 2021. https://www.bloomberg.com/news/features/2021-09-28/why-widening-highways-doesn-t-bring-traffic-relief (5 October 2021); Sam Mintz, "Democrats Look to Crush States Highway Habits," *politico.com*, Politico Transportation, 18 July 2021. https://www.politico.com/news/2021/07/18/democrats-states-highways-transportation-499906 (19 October 2021); Ian Duncan, "How a Quality of Life Award for a 12-Lane Utah Highway Sums up the Debate over the Future of transportation," *washintgonpost.com*, The Washington Post, 24 September 2021. https://www.washingtonpost.com/transportation/2021/09/24/lehi-utah-interstate-15-highway-award/ (19 October 2021).

[15] "Shift Calculator," *nrdc.org, t4america.org, rmi.org*, National Resources Defense Council, Transportation for America, RMI, October 2021. https://shift.rmi.org (8 Nov. 2021).

[16] Elizabeth Deakin et. al., "Calculating and Forecasting Induced Vehicle Miles of Travel Resulting from Highway Projects: Findings and Recommendations from an Expert Panel," *California Department of Transportation, dot.ca.gov*, September 2020. https://dot.ca.gov/-/media/dot-media/programs/ transportation-planning/documents/sb-743/2020-09-21-sb-743-expert-panel-rpt-fnl-a11y.pdf (5 Jan 2022).

[17] Patrick Tyner and Angela Shepard, "Shifting from LOS to VMT as the Measure of Transportation Impact Assessment," California Department of Transportation, dot.ca.gov, (italicize) June 2019. https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/research-results/2886-rr-a11y.pdf (5 Jan 2021).

In addition, since the outbreak of COVID-19, travel patterns have changed.[18] The morning peak period is shorter and has less traffic, while mid-days and Saturdays have increased volumes. Workers' commute mode has changed significantly; the percentage commuting by transit has declined by more than 50%, while work at home has seen the biggest increase. This significant change in travel patterns may have changed the location and frequency of induced demand.

[18] Steven Polzin, *Mass Transit Systems Face Critical Challenges Now and When COVID-19 Pandemic Is Over*, Reason Foundation, March 2021. https://reason.org/policy-brief/mass-transit-systems-face-critical-challenges-now-and-when-covid-19-pandemic-is-over/ (20 Dec. 2021). "COVID Transportation Trends: What You Need to Know About the New Normal," *streetlight.com*, Streetlight, October 2020. https://learn.streetlightdata.com/covid-transportation-trends (8 Nov 2021).

PART 3

FIVE POTENTIAL INDUCED DEMAND SCENARIOS

Determining the presence and magnitude of induced demand is complicated. Adding new capacity leading to more travel and in some cases, several years later, the return of congestion raises a series of questions. How much new traffic is due to growth? How much new travel is due to shifting commuting patterns such as a major employer moving to a new building several miles away? How much is due to changing technology or demographics? Does the new travel and return of congestion still net out to positive benefits from the new capacity? This section examines five scenarios to determine which qualify as induced demand and which do not.

3.1 GROWTH IN DEMAND ATTRIBUTABLE TO POPULATION, EMPLOYMENT, OR ACTIVITY GROWTH IN THE MARKET AREA SERVED BY THE ROADWAY

The debate over induced demand is raging in Austin, Texas, where TXDOT proposes widening I-35 to accommodate growth, and opponents respond that due to induced

demand the new lanes won't reduce congestion.[19] It's a classic case of opponents pretending the purpose of new capacity is to reduce congestion when the purpose is actually to allow more people to travel.

In July 2020, according to the U.S. Census Bureau the Austin metro area had 2,295,303 people, a 3% increase from the previous year.[20] Since 2010, the Austin metro area's population has increased by 34%, one of the highest growth rates in the country. Current migration patterns from cold-weather, high-tax states to warm weather, low-tax states suggest that the growth is likely to remain robust.[21] In October 2021, Tesla announced that it was relocating its corporate headquarters from Palo Alto, California to Austin.[22] Metro areas that have population and employment growth as high as Austin have a lot of new travel demand that is not induced by new pavement. Instead, adding new capacity is a sensible response to ensuring mobility in areas experiencing such growth. For example, for decades Houston dealt with rapid growth by adding capacity, which kept congestion from rising as much as it did in other major cities.[23]

Metro areas that have population and employment growth as high as Austin have a lot of new travel demand that is not induced by new pavement.

19 Zipper, "The Unstoppable Appeal of Highway Expansion."

20 "Austin TX Commuting Characteristics by Sex" U.S. Census Bureau, *data.census.gov*, 2020, https://data.census.gov/cedsci/table?q=S0801&g=400C100US04384&tid=ACSST1Y2019.S0801&hidePreview=true (8 Nov. 2021).

21 Darla Mercado, "COVID-19 Accelerated Retirement Moves as People Fled These High Tax States During 2020," cnbc.com, CNBC, 8 Jan. 2021. https://www.cnbc.com/2021/01/08/people-fled-from-these-high-tax-states-during-2020.html (20 Dec. 2021).

22 Lara Kolodny, "Tesla Moves Headquarters from California to Texas," *cnbc.com*, CNBC. 7 Oct. 2021, https://www.cnbc.com/2021/10/07/tesla-moves-its-headquarters-from-california-to-texas.html, (8 Nov. 2021).

23 Tory Gattis, "Houston Provides Lesson For How Fast-Growing Cities Can Relieve Congestion," *Market Urbanism Report*, November 30, 2018, https://marketurbanismreport.com/blog/houston-provides-lesson-for-how-fast-growing-cities-can-relieve-congestion

New transportation capacity can also impact land use within the metropolitan area as firms and residential builders seek to build near the new capacity. This new demand may not impact regionwide travel levels but may concentrate more activity in a given corridor and be characterized as induced demand by some, even though it is typically travel resulting from growth or longer trips to existing activities.

3.2 DEMAND ASSOCIATED WITH REDISTRIBUTING EXISTING TRAVELERS GEOGRAPHICALLY ACROSS THE ROADWAY NETWORK TO OPTIMIZE TRAVEL ROUTES

Even before navigation apps were sending folks driving through neighborhoods to avoid freeway traffic jams, drivers sought out alternative paths when congestion became severe.[24] New freeway capacity may induce travelers to switch from surface streets to freeways, which has several advantages. Traveling on freeways is preferable to traveling on surface streets as freeways are quicker (due to higher travel speeds), less circuitous, produce less greenhouse gas emissions than urban stop-and-go local travel, and are safer.[25] Fatality rates for urban freeways are typically only half as high as they are for urban arterials.[26] Freeway travel eliminates the risks of pedestrian and bicycle accidents (in most states), a growing share of all fatalities. Encouraging diverted demand to use a freeway corridor offers several positive impacts. These changes result in different travel routes but the demand is not new and is thus not induced.

3.3 DEMAND ASSOCIATED WITH EXISTING TRAVELERS CHANGING THEIR TRAVEL TIME TO TAKE ADVANTAGE OF ADDITIONAL CAPACITY AT PREFERRED TRAVEL TIMES

The shift of travel times is most prominent in peak hours, where new capacity means more people can travel during those high-demand hours than could before.[27] This shift could

24 "Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation," *ops.fhwa.dot. gov*, Federal Highway Administration Office of Operations, 23 Mar. 2020. https://ops.fhwa.dot.gov/congestion_report/chapter2.htm (20 Dec. 2021).

25 "The Highway System," Federal Highway Administration, *fhwa.org*, 29 Mar. 2018. https://www.fhwa.dot.gov/ohim/onh00/onh2p5.htm (8 Nov. 2021).

26 "Traffic Safety Facts Annual Report Tables," National Highway Traffic Safety Administration, cdan.nhsa.gov, December 2020. https://cdan.nhtsa.gov/tsftables/tsfar.htm (8 Oct. 2021).

27 Downs, "Traffic: Why It's Getting Worse, What Government Can Do."

mean the return of peak-hour congestion after a short respite. This shift has no effect on total volumes on the system and is therefore not induced. Instead, it enables individuals and commercial vehicle drivers to travel on the preferred route at more desirable times. A parent may get home in time to eat with their family, attend a sporting event, or proctor homework. A transport vehicle may be able to make a more-timely delivery, or an emergency vehicle may be able to reach a burning building more quickly. These benefits improve the quality of life for the travelers, the community, and commercial vehicles.

3.4 DEMAND ASSOCIATED WITH EXISTING TRAVEL SHIFTING FROM ALTERNATIVE MODES DUE TO NEW ROADWAYS OR MISSING LINKS IN EXISTING ROADWAYS

Travel shifting from other modes to automobiles due to increased roadway capacity is legitimately induced demand.[28] These mode shifts could be from ride-sharing to driving alone, from transit to driving, or from bicycling or walking to driving. For shared rides, new capacity may reduce the stress or time commitment required of driving alone, thus causing carpoolers to switch to single-occupant driving. Faster roadway travel enabled by new capacity may slightly alter the appeal of driving relative to bicycling or walking.

> *...while new roadway capacity has shifted a small but real number of travelers in the past, today, there is less travel on other modes to shift and be induced to use new roadway capacity.*

However, while new roadway capacity has shifted a small but real number of travelers in the past, today, there is less travel on other modes to shift and be induced to use new roadway capacity. Between 1980 and 2019, the national percentage of shared ride or carpooling for commuting has decreased from 20% to 8.9%.[29] In that same time period,

[28] Downs, "Traffic: Why It's Getting Worse, What Government Can Do."

[29] Michael Burrows, Charlynn Burd, and Brian McKenzie, "Commuting by Public Transportation in the United States: 2019," U.S. Census Bureau, American Community Survey, *census.gov*, April 2021, https://www.census.gov/content/dam/Census/library/publications/2021/acs/acs-48.pdf, (8 Nov. 2021).

transit use has decreased from over 6% to 5% and walking has declined from 5.6% to 2.6%.[30] In 2019, in Austin, 82.7% of all commuters used an automobile. Another 10.7% worked from home. Only 10.9% of travel can be induced, divided among carpooling (4.5% or half 8.9%), transit (2.3%), walking (2.2%), bicycling (0.8%), and other modes (1.4%). This is not a lot of potential travel to be induced to use new roadway capacity.[31] Further, in a post-COVID world with so many people working and shopping from home, this total that can be induced is likely to be even lower.

The issue of mode shifts in the context of induced demand is particularly relevant, as some planners see the lack of new roadway capacity as a motivation for folks to shift to alternative modes.[32] But is that realistic? For some perspective, a metropolitan area with 3% sustained population growth and 2% transit commute share such as Austin would produce enough new commuters that keeping roadway volumes constant would require increasing transit commuting by 150% annually—a feat never accomplished in urban transit.

3.5 DEMAND ASSOCIATED WITH NEW TRIP GENERATION OR TRIP LENGTH INCREASES AS THE TRIP DISTRIBUTION PATTERN CHANGES

Some of the new demand consists of people who wanted to travel previously, but high levels of congestion made some of their desired trips not worth the travel time.[33] This category is the largest, and likely only significant measure of induced demand, as it is travel that without new capacity would not have occurred. This is not to say that there was no demand for those trips—there was, but not at the cost imposed by current levels of congestion.

However, for induced demand to occur, the improved travel options (faster time, lower cost) resulting from the reduced congestion must result in a new willingness to travel more

30 "Commuting in America 2013," *transportation.org*, American Association of State Highway and Transportation Officials, Figure ES-11, 2013, https://traveltrends.transportation.org/portfolio/cia-2013-executive-summary/,(8 Oct 2021).

31 "Commuting Characteristics by Sex: Austin," *data.census.gov*, U.S. Census Bureau, American Community Survey 2019, https://data.census.gov/cedsci/table?q=S0801%20Austin,%20tx&text=S0801&g=400C100US04384&tid=ACSST1Y2019.S0801 (8 Oct 2021).

32 Zipper, "The Unstoppable Appeal of Highway Expansion."

33 Ibid.

and/or farther.[34] For example, a driver may choose to travel a few additional miles to shop in a store that may have more choices or lower prices, be motivated to take a better job that has a longer commute, or make an additional trip that might have previously been deemed too burdensome.

> *Some of the new demand consists of people who wanted to travel previously, but high levels of congestion made some of their desired trips not worth the travel time.*

These trips do occur. Historically, society has deemed them desirable economic outcomes of enhanced mobility created by adding new connections or new capacity.[35] For example, a plumber might be able to reach one more customer for repairs each day, or a family with two workers might be able to locate where their commutes are shorter and enjoy more family time.

However, even if there is a logical connection between new capacity and new demand from existing users, it is not easy to attribute the new travel to new capacity because of changes in trip generation and trip length trends. Levels of induced travel demand have changed over time. As shown in Figure 1, vehicle-miles of travel (VMT) per capita has moderated and as of 2019 had not returned to the peak levels in the 2004–2007 period.[36] Before that point in time, VMT per capita had been growing despite the lack of new capacity. Between 1980 and 2015, national lane-miles of all roadways increased by about 11% and Interstate and freeway lane-miles increased 39.6%, while vehicle-miles of travel (VMT) increased over

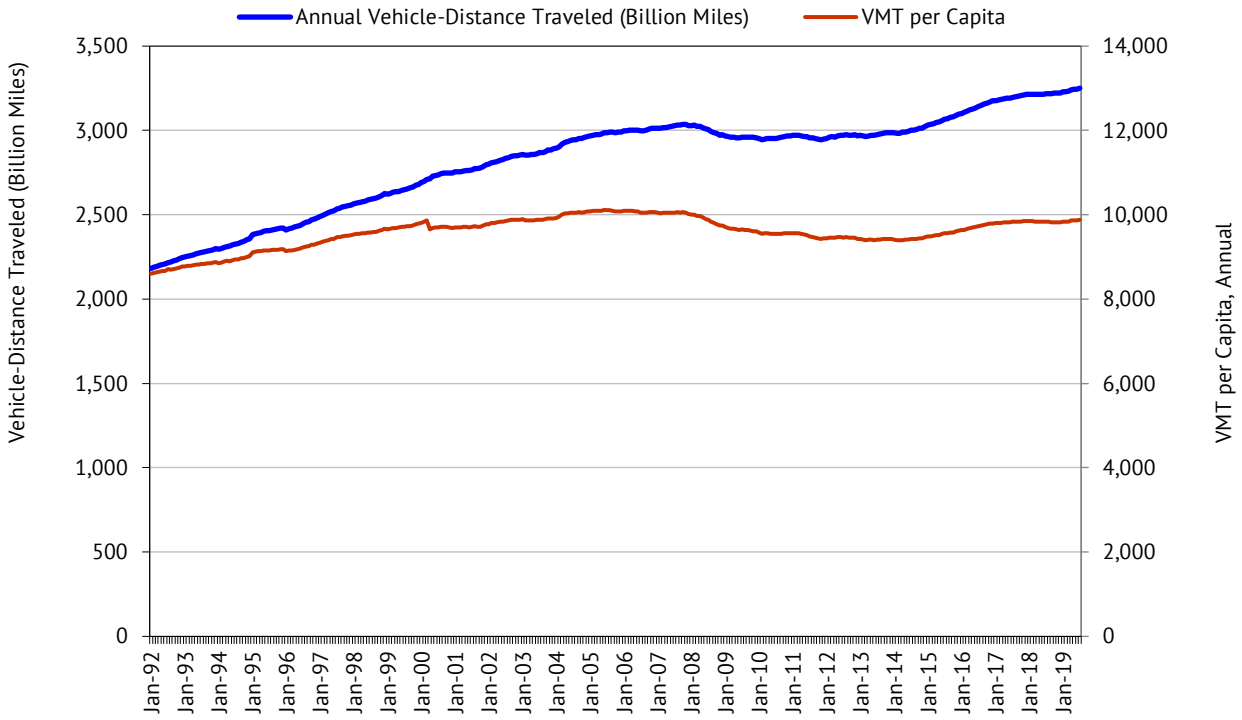
[34] Baruch Feigenbaum, "Increasing Mobility in Southern California: A New Approach," Reason Foundation. November 2015. https://reason.org/wp-content/uploads/2015/11/southern_california_mobility_plan.pdf (20 Dec. 2021).

[35] "Productivity and the Highway Network: A Look at the Economic Benefits to Industry from Investment in the Highway Network," Federal Highway Administration, *fhwa.dot.gov*, 7 Nov. 2014. https://www.fhwa.dot.gov/policy/otps/060320b/ (20 Dec. 2021).

[36] "Annual Vehicle Distance Traveled in Miles and Related Data-2019(1) By Highway Category and Vehicle Type," Federal Highway Administration, *fhwa.dot.gov*, 2019. https://www.fhwa.dot.gov/policyinformation/statistics/2019/pdf/vm1.pdf (20 Dec. 2021).

100%.[37] In other words, in many locations, demand was increasing even though roadway capacity remained constant. At the national level we have not added significant new capacity (despite what some have argued) and yet we had growing per capita travel demand—arguably demand-induced despite lacking new capacity.

FIGURE 1: TRENDS IN VEHICLE-MILES OF TRAVEL AND VMT PER PERSON



Source: USDOT VMT per Capita https://www.transportation.gov/mission/health/vmt-capita, USDOT Annual Vehicle Distance Traveled in Miles and Related Data 2019, https://www.fhwa.dot.gov/policyinformation/statistics/2019/pdf/vm1.pdf

All five of these scenarios point out that typically induced demand is not the primary force responsible for congestion returning. They also reinforce that the decision on the total costs and benefits of new capacity is a complex one, including many internalized and external costs and benefits to all parties. Simple declarations that congestion typically returns after new capacity is added ignore any analysis of these costs and benefits.

[37] "Public Road Mileage, Lane Miles, and VMT," Federal Highway Administration, *fhwa.dot.gov*, 1 Dec. 2020, https://www.fhwa.dot.gov/policyinformation/statistics/2019/vmt421c.cfm (8 Oct 2021).

PART 4

WHY TODAY'S TRAVEL PATTERNS MAY LEAD TO LOWER RATES OF INDUCED DEMAND

As noted in Part 3, just because induced demand could exist for a given capacity expansion does not mean that it does exist. And the factors that led to induced demand in the 20th and early 21st centuries have changed in recent years. This section details four reasons why the level of induced demand is likely to be significantly lower moving forward.

4.1 THE MODERATION IN PER CAPITA DEMAND

This moderation is confirmed by declines in trip generation per capita as revealed in the National Household Travel Survey data.[38] As detailed in a report for the USDOT, "The Case for Moderate Growth in Vehicle Miles of Travel (VMT): A Critical Juncture in U.S. Travel Behavior Trends," several trends that increased VMT have moderated or played themselves

[38] "Summary of Travel Trends," Federal Highway Administration, *fhwa.dot.gov*, 2019. https://www.fhwa.dot.gov/policyinformation/documents/2017_nhts_summary_travel_trends.pdf (8 Oct. 2021).

out.[39] Suburbanization, declining household size, women joining the workforce, increased auto ownership, and diminished opportunities to shift from other modes are no longer increasing VMT growth and thus no longer suggesting high levels of induced demand.

4.2 THE SUBSTITUTION OF COMMUNICATIONS FOR TRAVEL

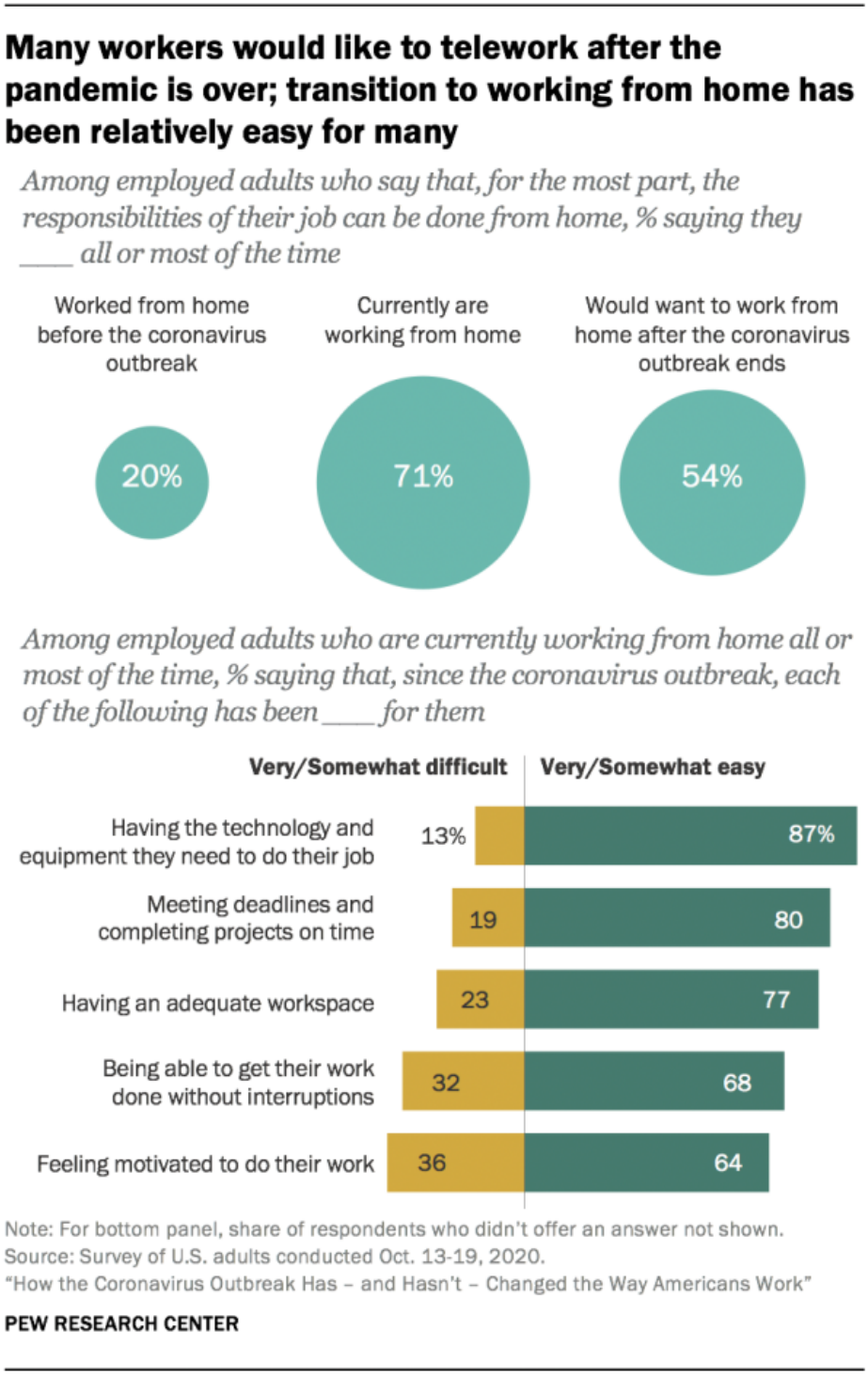
The emerging opportunity to broadly substitute communications for travel is also likely to reduce induced demand.[40] Telecommuting is the most apparent example of where people are choosing to use communications technologies in lieu of travel. The work-at-home mode share grew from 2.3% in 1980 to 5.9% in 2019.[41] COVID increased the mode share dramatically, resulting in expectations that the post-COVID work-at-home share will remain in double digits and increase as the share of information jobs in the economy increases (Figure 2). E-commerce, distance learning, online business transactions, and telemedicine are likely to grow as well, moderating the demand for increasing vehicle travel.

39 Steven Polzin, "The Case for Moderate Growth in Vehicle Miles of Travel: A Critical Juncture in U.S. Travel Behavior Trends," U.S. Department of Transportation, rosa.nlt.bts.gov, April 2006. https://rosap.ntl.bts.gov/view/dot/18144, (8 Oct 2021).

40 Steven Polzin, "Public Transportation Must Change After Covid-19," Reason Foundation, March 2021. https://reason.org/wp-content/uploads/public-transportation-must-change-after-covid-19.pdf (13 Dec. 2021).

41 "U.S. Commuting Characteristics by Sex" U.S. Census Bureau, *data.census.gov*, 2020. https://data.census.gov/cedsci/table?q=S0801&g=0100000US&tid=ACSST1Y2019.S0801&hidePreview=true, (8 Nov. 2021).

FIGURE 2: THE FUTURE OF TELEWORK



Source: Pew Research Center, *How the Coronavirus Outbreak Has – and Hasn't – Changed the Way Americans Work*, December 2020, https://www.pewresearch.org/social-trends/2020/12/09/how-the-coronavirus-outbreak-has-and-hasnt-changed-the-way-americans-work/

4.3 THE GROWTH OF COMMERCIAL AND SERVICE VEHICLES

Another consideration in calculations of induced demand is that a growing share of roadway travel is not household-based personal travel but commercial and service vehicle travel responding to business, government, and household needs.[42] This includes police, fire, ambulance, mail, school buses, delivery vehicles, and the myriad of services from lawn, insect, pool, and repair services and sales and service visits such as home health care, realtors, and decorators. Federal Highway Administration (FHWA) VMT and National Household Travel Survey (NHTS) data suggest that the share of travel in this category constitutes as much as 20.5% and is growing as shown in Table 1.[43] There is no empirical evidence that commercial and service vehicle travel is sensitive to roadway capacity and, importantly, this demand cannot use alternative modes in the absence of new capacity.

TABLE 1: SOURCES OF ROADWAY VEHICLE-MILES TRAVELED

	2009		2017	
	Percent of Household VMT	**Percent of all Roadway VMT**	**Percent of Household VMT**	**Percent of all Roadway VMT**
Household Travel [A]				
Commuting	27.8%	76%	30.2%	70.4%
Work Related/Business	9.0%		3.2%	
Other Household Travel	63.2%		66.6%	
Subtotal	100%		100%	
Public and Commercial Travel				
Public Vehicle Travel [B]		2%		20.5%[E]
Utility/Service/Commercial Travel [C]		12%		
Heavy Freight and Goods[D]		10%		9.1%
Total		100%		100%

Sources: Author's analysis of National Household Travel Survey data and FHWA VMT data as initially reported in Commuting in America 2013 and updated with 2017 NHTS data.[44]

42 "2021 Traffic Volume Trends," Federal Highway Administration Office of Highway Policy Information, *fhwa.dot.gov*, 2021, https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm (8 Nov. 2021), "National Household Travel Survey," Federal Highway Administration, *nhts.ornl.gov*, 2017, https://nhts.ornl.gov (8 Nov. 2021).

43 Ibid.

44 Sources for specific elements of Table 1:

A. FHWA estimate based on NHTS data: https://nhts.ornl.gov.

B. FHWA estimate using vehicle registration data: https://www.fhwa.dot.gov/policyinformation/statistics/2017/mv1.cfm

4.4 THE UNCERTAINTY OF THE FUTURE

> *Policymakers have never been great at predicting the future, but the combination of the effects of COVID-19 and rapid technological change make forecasting in today's environment particularly difficult.*

Policymakers have never been great at predicting the future, but the combination of the effects of COVID-19 and rapid technological change make forecasting in today's environment particularly difficult. Predicting settlement patterns, the rate of population growth, and the number of immigrants is very challenging.[45] Emerging automated vehicle technologies might increase or decrease the number of trips depending on how the technology is used and its effects on travel patterns.[46] But combined with connectivity to road-based systems they can increase throughput on existing capacity—effectively increasing the capacity of existing infrastructure. The rise of personal mobility devices and micro transit services and ridesharing are having substantial impact on travel choices, especially in urban areas.[47] With so little clarity, transportation agencies can more easily err today than in the past by either building too much or not enough new capacity. It seems likely that policymakers will be cautious about assuming increasing demand for capacity, while learning about the new normal and how to improve mobility with emerging technologies.

C. FHWA estimate based on HPMS data and NHTS: https://www.fhwa.dot.gov/policyinformation/datalinks.cfm

D. FHWA estimate based on HPMS data: https://www.fhwa.dot.gov/ohim/hpmsmanl/appn.cfm

E. Derived by subtracting NHTS household VMT and FHWA heavy truck VMT from total VMT.

45 Polzin, *Public Transportation Must Change.*

46 Ronald Milam et. al. "Using Current Practice Regional Models to Test Autonomous Vehicle Effects on Travel Demand and Public Agency Policy Responses," *fehrandpeers.com,* Fehr and Peers, 31 July 2019. https://www.fehrandpeers.com/wp-content/uploads/2020/01/Milam_Islam_Johnson_Fong_Donkor_Xu_AV-Modeling_TRB_2020.pdf (20 Dec. 2021).

47 Susan Shaheen, Adam Cohen, and Ismail Zohdy, "Shared Mobility: Current Practices and Guiding Principles," Federal Highway Administration, *ops.fhwa.dot.gov*, April 2016. https://ops.fhwa.dot.gov/publications/fhwahop16022/fhwahop16022.pdf (20 Dec. 2021).

PART 5

ADVANTAGES OF ECONOMIC ACTIVITIES THAT CREATE INDUCED DEMAND

Highways are the only type of transportation mode where inducing new demand is considered bad. For transit, an increase in rail or bus ridership is considered a positive.[48] For aviation, additional airplane flights help provide more-frequent links to some cities and direct links to others.[49] For maritime, a larger port that handles additional cargo is a boon for U.S. consumers.[50] For freight rail, additional tracks allow railroads to transport more

48 "There's a Reason Transit Ridership is Increasing in These Seven Cities," *transitcenter.org*, TransitCenter, 27 Feb. 2019. https://transitcenter.org/theres-a-reason-transit-ridership-is-rising-in-these-7-cities/ (20 Dec. 2021).

49 Dawn Gilbertson, "New Airline Breeze Airways Takes Off with $39 Fares, No Middle Seats and Nonstop Flights to Smaller Cities," *USA Today*, 21 May 2021. u*satoday.com*, https://www.usatoday.com/story/travel/airline-news/2021/05/21/breeze-airways-fares-fleet-routes-tampa-charleston-new-orleans-norfolk/7411802002/ (20 Dec. 2021).

50 David Lynch, "Stubborn Supply Chain Woes are Resisting Biden's Remedies," *Washington Post*, 26 Oct. 2021, *washingtonpost.com*, https://www.washingtonpost.com/business/2021/10/26/supply-chain-ports-fees-biden/ (20 Dec. 2021).

goods.[51] Policymakers rarely complain about more people using light rail lines, but to some laying one additional mile of roadway represents an existential threat.

And the more-is-better rationale holds for other services as well. Using more natural gas to moderate the temperature inside a building is vital on cold days. Using more broadband to access a Zoom meeting improves productivity. Nobody has argued for halting school construction or banning new reservoirs to slow growth. Highways seem to receive special treatment.

Even when new highway capacity will lead to the type of congestion and other external costs that smart growth advocates describe, that does not mean that the new capacity does not have benefits. Even if we accept the concept of induced demand, a benefit-cost analysis may show the benefits of new capacity exceed its costs.[52] How can this be? New capacity has additional benefits beyond congestion relief.

Even if we accept the concept of induced demand, a benefit-cost analysis may show the benefits of new capacity exceed its costs.

5.1 NEW CAPACITY CAN ALLOW TRAVEL AT THE PREFERRED TIME IN THE PREFERRED MODE

The additional induced commuters that are using the highway are traveling on the roadway, at the time and by the mode that they prefer. Their shift in travel behavior is a net benefit to them. The new capacity may allow them to get home for work in time to cook dinner instead of order takeout. The highway improvement may induce them to enroll their child in a soccer league, whose practices were otherwise too cumbersome to reach. The improvement may allow them to take a job that is closer to home, or a better match for

[51] Michael Webber, "Freight Trains are Our Future," *popsci.com*, 9 May 2019, https://www.popsci.com/power-trip-excerpt/ (20 Dec. 2021).

[52] "Operations Benefit/Cost Analysis Desk Reference," U.S. Department of Transportation Federal Highway Administration, *ops.fhwa.dot.gov*, 2021, https://ops.fhwa.dot.gov/publications/fhwahop12028/sec2.htm (20 Dec. 2021).

their skillset, or better paying—or all three. The reality is that those additional induced travelers aren't out on the highway to drive for driving's sake; they are driving to engage in an activity that brings them happiness and satisfaction.

5.2 NEW CAPACITY CAN GENERATE ECONOMIC ACTIVITY

Many of the induced trips lead to economic activity.[53] Without the new lanes, not enough customers would be able to access a specialty grocery store, causing it to close. Without the new lanes, a religious group might not have enough members to justify building a place of worship. The new lanes would even affect a professional sports franchise. Without the new capacity the team would not draw enough spectators to be viable. These trips lead to actual activity that improves the local economy, both for the directly affected parties and everyone else in the region.

Some political leaders believe that outsourcing the production of electronics and pharmaceuticals has led to problems with the supply chain.[54] Bringing manufacturing and production activities back to the U.S. may reduce resource consumption but it will increase the need for additional roadway capacity.

5.3 NEW CAPACITY CAN IMPROVE SAFETY

The motivation for widening many highways and other capacity additions is not congestion relief but safety. New capacity can be engineered to the latest safety designs and can be much safer than older infrastructure. A four-lane highway has significantly fewer accidents per lane-mile than a two-lane roadway.[55] And those accidents that do occur are less deadly. Two-lane highways have a higher percentage of head-to-head collisions resulting from one vehicle trying to pass another vehicle and the first vehicle colliding with a third vehicle traveling in the opposite direction. New roadways, new lanes, elevated or tunnel lanes, and

53 The relationship between additional travel and economic growth is complex, and cuts both ways, but are clearly interlinked. Liisa Ecola and Martin Wachs, "Exploring the Relationship between Travel Demand and Economic Growth," *fhwa.gov*, December 2012, https://www.fhwa.dot.gov/policy/otps/pubs/vmt_gdp/vmt_gdp.pdf (20 Dec. 2021).

54 "Risk, Resilience, and Rebalancing in Global Value Chains," *mckinsey.com*, McKinsey Global Institute, 6 Aug. 2020, https://www.mckinsey.com/business-functions/operations/our-insights/risk-resilience-and-rebalancing-in-global-value-chains (20 Dec. 2021).

55 "Traffic Safety Facts Annual Report Tables," National Highway Traffic Safety Administration.

new bridges, for example, can be engineered to be safer than older infrastructure. The first priority of most transportation agencies is safety.

> *The motivation for widening many highways and other capacity additions is not congestion relief but safety. New capacity can be engineered to the latest safety designs and can be much safer than older infrastructure.*

5.4 NEW CAPACITY CAN REDUCE GREENHOUSE GAS EMISSIONS

While it may sound counterintuitive, new capacity can reduce greenhouse gas emissions (GHGs). GHG emissions are a U-shaped curve with the highest emissions at extremely low speeds and the lowest emissions at moderate speeds.[56] If new capacity raises the average travel speeds on a highway from 10 mph to 40 mph, even an increased number of vehicles will produce fewer greenhouse gas emissions. Maintaining free-flowing traffic, which can be accomplished by some form of pricing, as discussed in the next section, is essential.

> *If new capacity raises the average travel speeds on a highway from 10 mph to 40 mph, even an increased number of vehicles will produce fewer greenhouse gas emissions.*

[56] Matthew Barth and Kanok Boriboonsomsin, "Traffic Congestion and Greenhouse Gases," *Accessmagazine.org*, Fall 2009, https://www.accessmagazine.org/wp-content/uploads/sites/7/2016/01/access35_Traffic_Congestion_and_Grenhouse_Gases.pdf (8 Nov. 2021).

PART 6

THE MOST EFFECTIVE TOOL FOR REDUCING INDUCED DEMAND: PRICING

As Part 5 explained, new capacity (which may lead to induced demand) can be a good thing. It has benefits as well as costs. Rather than restricting capacity to try to reduce auto travel, decisions about new capacity should consider all of the costs and benefits. And that can include ways in which new capacity can improve transit services such as express buses or bus-rapid transit. For example, shifting demand to transit only benefits the environment if transit vehicles are near capacity. Redistributing land use activities is only helpful if the capital and operating costs of redistribution are less than the resources saved from an optimized transportation network.

However, if the policy goal is for several lanes or an entire highway to remain free flowing, the best solution may be new capacity with some form of pricing.

> *... if the policy goal is for several lanes or an entire highway to remain free flowing, the best solution may be new capacity with some form of pricing.*

There are four types of priced highways in the U.S.: managed lanes, toll highways, congestion pricing, and cordon pricing.

6.1 MANAGED LANES

Managed lanes are the most popular type of new priced capacity. Managed lanes price one or more lanes with rates adjusted to rise and fall with congestion. Many facilities price lanes dynamically to fluctuate in real time based on current demand, while others fix various prices based on the day and time. Managed lane tolls vary to keep traffic moving between 45 and 65 mph and range from a nickel to more than one dollar per mile.[57] Some highways provide free passage to carpools, but pricing is more effective on lanes that offer free passage to vanpools and buses only, leaving more vehicles responsive to the change in price. Using a revenue-risk public private partnership (P3) to build the lane can help improve the life-cycle costs and quality of the lanes as well as transfer revenue risk to the private party.[58] Facilities with at least two managed lanes in each direction tend to operate more efficiently, but all types of managed lanes help reduce induced demand while preserving the environmental, economic, and quality of life benefits of free-flowing traffic.

[57] "Managed Lanes: A Primer," Federal Highway Administration Office of Operations, *ops.fhwa.dot.gov*, 1 Feb. 2017, https://ops.fhwa.dot.gov/publications/managelanes_primer/ (8 Oct. 2021); Baruch Feigenbaum, *Managed Lanes Connecting Metro Areas: The Pragmatic Solution*, Reason Foundation, April 2019, https://reason.org/wp-content/uploads/managed-lanes-between-metro-areas-the-pragmatic-solution.pdf.

[58] "Public Private Partnership Concessions for Highway Projects: A Primer," Federal Highway Administration, *fhwa.dot.gov*, October 2010, https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_concession_primer.pdf (8 Oct. 2021).

6.2 TOLL HIGHWAYS

Toll highways are a popular option in quickly growing states such as Colorado, Florida, Texas, and Virginia. The tolls provide the revenue needed to build, maintain, and operate the facility.[59] Some highways have fixed-price tolls, while others charge different rates based on the time of day. Similar to managed lanes, tolled highways operate more efficiently than free highways. P3s are a good option for delivering the new toll roads.

6.3 CONGESTION PRICING

Congestion pricing is used in many metro areas across the world, but it is rare in the U.S. With congestion pricing, all of the lanes on a highway are priced to manage congestion.[60] The average toll per mile for congested highways is designed to keep traffic moving between 45 and 65 mph and varies more than for managed lanes, typically between a nickel and $4.00. There is only one congestion-priced highway in the U.S.: I-66 in Virginia inside the Beltway.[61] And it is only priced peak direction, peak period (eastbound weekday mornings and westbound weekday evenings). Other regions, including Portland, Oregon, are examining congestion pricing their Interstate highway network to manage demand.[62] As with managed lanes and toll highways, congestion pricing entire highways helps manage congestion.

59 Robert W. Poole Jr., *Value-Added Tolling: A Better Deal for America's Highway Users*, Reason Foundation, March 2014, https://reason.org/wp-content/uploads/2014/03/value_added_tolling.pdf

60 "What is Congestion Pricing," Federal Highway Administration Office of Operations, *ops.fhwa.dot.gov*, 5 April 2019. https://ops.fhwa.dot.gov/publications/congestionpricing/sec2.htm (8 Oct 2021).

61 "Using the Lanes," *66expresslanes.org*, 66 Express Lanes, 2021. http://66expresslanes.org/using_the_lanes/default.asp (21 Dec. 2021).

62 "Regional Congestion Pricing Study," Metro, *oregonmetro.gov*, September 2021, https://www.oregonmetro.gov/regional-congestion-pricing-study, (8 Nov. 2021).

6.4 CORDON PRICING

Cordon pricing is used in several regions throughout the world, including Singapore and London.[63] A version of cordon pricing is coming to lower- and midtown-Manhattan.[64] Cordon pricing charges a fee to enter a certain zone or area of the city. The rate can be fixed or vary based on day and time. As with the other three tolling options, cordon pricing helps manage congestion.

[63] Matt Rosenberg, "The Difference Between Cordon Pricing and Congestion Pricing," *Cascadia.center* Cascadia Center, 8 April 2008, https://cascadia.center/blog/2008/cordon_pricing_plan_fails_in_n/ (8 Oct. 2021).

[64] Michael Gold, "Congestion Pricing is Coming to New York: Everyone Has an Opinion," *The New York Times*, 21 Oct. 2021, *nytimes.com*, *https://www.nytimes.com/2021/09/29/nyregion/nyc-congestion-pricing.html* (21 Dec. 2021).

PART 7

CONCLUSION

Whenever a department of transportation proposes building a new highway or widening an existing one, some smart growth groups immediately claim the improvement will lead to induced demand. But detecting and quantifying induced demand is a complicated task. And as researchers Anthony Downs and Robert Cervero noted, just because there is induced demand does not mean that it is a bad thing.

“And as researchers Anthony Downs and Robert Cervero noted, just because there is induced demand does not mean that it is a bad thing.”

Increasing demand for travel leads to the need for new capacity, not the other way around. As detailed in Part 3, the following five factors lead to higher travel demand:

1. Growth in demand attributable to population, employment, or new activities in the market area served by the roadway
2. Redistribution of existing travelers geographically across the roadway network to optimize travel routes
3. Altered travel times that take advantage of additional capacity at preferred travel times

4. Modified travel modes resulting from new roadways or missing links in existing roadways
5. New trip generation or trip length increases as trip distribution patterns change

Only the latter two are legitimately induced demand. And only demand associated with new trip generation or increased trip length is a significant contributor to induced demand. At the same time *all five* sources of demand for new capacity are driven by the benefits of additional travel. New capacity brings many benefits as well as costs, and all have to be evaluated.

While induced demand was a significant concern in the 20th century, the shifting nature of travel, including the increase in working at home and growth in the services economy, is likely to reduce induced demand in the foreseeable future. Further, induced demand is not always bad, because new capacity creating the demand allows folks to travel when and where they want, creates economic activity, and improves safety.

Finally, the most effective method for reducing induced demand is to implement pricing. By charging drivers the true economic cost of using a roadway, pricing helps reduce discretionary trips and better manages roadway congestion.

RECOMMENDED READINGS ON INDUCED DEMAND

Following are a series of writings on induced demand from researchers across the ideological spectrum. Readers are encouraged to explore multiple works.

Cervero, Robert, Hansen, Mark, September 2002, Induced Travel Demand and Induced Road Investment: A Simultaneous Equation Analysis, Journal of Transport Economics and Policy (JTEP), Volume 36, Number 3, 1, 469-490(22)

Cervero, Robert, 2003, Road Expansion, Urban Growth, and Induced Travel: A Path Analysis, Journal of the American Planning Association, Taylor & Francis

Dunkerley, Fay, Laird, James, Whittaker, 2018, Induced Travel Demand: An Evidence Review, Rand Europe/WSP, Induced Travel Demand: An Evidence Review | RAND

DeCorla-Souza, Patrick, Cohen, Harry, 1999, Estimating induced travel for evaluation of metropolitan highway expansion, Transportation, Vol 26, Issue 3, 249-262.

Dittmar, H. 1998, Do new roads cause congestion? Surface Transportation Policy Project Progress 8, 2: 1-1, 4-4, 6-6

Downs, A., 1992, Stuck in traffic: Coping with peak-hour traffic congestion, Washington, DC: Brookings Institution

EPA, 2002, Guidebook on Induced Travel Demand, https://nepis.epa.gov/Exe/ZyPDF.cgi/94004L98.PDF?Dockey=94004L98.PDF

Lee, Douglass B., Jr., Klein, Lisa, Camus, Gregorio, January 1, 1999, Induced Traffic and Induced Demand, U.S. Department of Transportation, Volpe Center, Cambridge, MA https://doi.org/10.3141/1659-09

Litman, Todd, April 2021, Generated Traffic and Induced Travel Implications for Transport Planning, Victoria Transport Policy Institute https://www.vtpi.org/gentraf.pdf

Noland, RB, 2001, Relationships between highway capacity and induced vehicle travel, Transportation Research Part A: Policy and Practice, Elsevier, Relationships between highway capacity and induced vehicle travel - ScienceDirect

Schneider, Benjamin, “CityLab University: Induced Demand,” *CityLab*, September 2018.

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