UCLA Luskin Center for History and Policy

A CENTURY OF FIGHTING TRAFFIC CONGESTION IN LOS ANGELES

1920-2020

BY MARTIN WACHS, PETER SEBASTIAN CHESNEY, AND YU HONG HWANG

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Preface

> *"Understanding why traffic congestion matters is … not a matter of documenting real, observable conditions, but rather one of revealing shared cultural understandings."*
> *Asha Weinstein*[1]

The UCLA Luskin Center for History and Policy was founded in 2017 through a generous gift from Meyer and Renee Luskin. It is focused on bringing historical knowledge to bear on today's policy deliberations. Meyer Luskin stated that "The best way to choose the path to the future is to know the roads that brought us to the present." This study is quite literally about roads that brought us to the present.

The Los Angeles region is considering alternative forms of pricing roads in order to address its chronic congestion. This is a brief history of a century of effort to cope with traffic congestion, a perennial policy challenge in this region. The authors, like the Luskins, believe that the current public debate and ongoing technical studies should be informed by an understanding of the past. We do not duplicate technical or factual information about the current situation that is available elsewhere and under scrutiny by others. We also do not delve deeply into particular historical events or past policies. We hope this overview will be useful to lay people and policy practitioners participating in the public dialog about dynamic road pricing that will take place over the coming several years. Our intended audience is neither transportation engineers and planners nor academic historians. The footnotes will hopefully lead those interested in greater depth to sources they will find useful.

The authors express gratitude to the Luskin Center for its support, and to its Director, Professor David Myers, for his guidance throughout the project. Maia Ferdman, the Luskin Center's Program Manager, administered the project and edited and formatted this report. Sona Babayan helped us by gathering information about congestion pricing in other countries. Elham Shirazi offered advice about telecommuting. We received helpful comments on an early draft from Professors Asha Agrawal, Eric Avila, William Deverell, Genevieve Giuliano, Michael Manville, David Myers, Peter Norton, Virginia Schaarf, Elliott Sclar, Donald Shoup, and Brian D. Taylor, and from Norman Emerson, Steven Finnegan, Zachary Pitts,Paul Taylor, Helen Wachs, Zev Yaroslavsky, and Tom Zoellner. Thank you to Thien Phan for formatting support for the adjoining timeline.

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Executive Summary

The Los Angeles Metropolitan Transportation Authority (Metro) started studying congestion pricing in late 2019 as a way to manage the region's heavy traffic and unpredictable travel times. Unusually light traffic during the recent pause in economic and social activity because of COVID-19 has highlighted the contrast between the usual traffic and surprisingly free flow. Traffic is a byproduct of vibrant economic and social activity and when L.A. rebounds, congestion is likely to return. The uncertain path to economic recovery makes this an opportune moment to consider future policy options that are effective and equitable.

As policymakers consider arguments for and against dynamic pricing of road travel and review pricing programs in more than forty other cities, they should also be informed by insights from countless alternative approaches to congestion reduction tried in past decades right here in Southern California. This white paper documents the region's persistent struggle to reduce congestion and explains why it has increased in spite of these programs – and sometimes because of them.

Travel patterns in Los Angeles predate the advent of the automobile. In its early decades, electric street railway companies encouraged decentralization and literally built the early suburbs to decongest the urban core. Population grew rapidly just as cars became widely available and early transit suburbs increasingly attracted auto owners. Traffic growth slowed streetcar service and the city imposed a wide variety of regulations to reduce congestion, banning horses, left turns, street parking, and jitneys. Signals and, much later, computers programmed to "optimize" flow all aimed to make traffic flow smoothly. Streets were widened, parking garages added, tunnels, viaducts, and freeways built, subways started, and busways constructed. Better information guided travelers to their destinations, starting with police in blimps directing traffic and moving on to helicopters, radio traffic reports, and ultimately sensors in the pavement linked to communications centers and smartphone apps directing individual drivers. Officials sincerely informed the people they served that each innovation would fix the city's traffic congestion, but history shows that traffic flows grew each time they expanded the transportation system.

Each past innovation seemed promising, but traffic is complex and it confounded every effort to reduce it. Where improvements made traffic flow more smoothly, people adjusted the times, places, and modes by which they traveled, and congestion returned. Land was developed where road and transit capacity encouraged growth and that created more traffic. Concentrating development in dense activity centers to reduce traffic fostered neighborhoods that generated more auto trips per acre. Dispersing communities to reduce traffic led to fewer trips per acre but longer car trips and less transit use. Dense traffic flows slowed bus service in the city and in the suburbs transit was slow, infrequent, and costly to provide.

Dynamic road pricing, now being studied by Metro, is not a new idea. It was first proposed a hundred years ago and has been advocated by both progressives and conservatives ever since. Proposals to manage traffic in Los Angeles must respond to the land use and transportation landscape that resulted from past programs that we hardly remember. The greatest challenges to dynamic road pricing relate to conflicting views of fairness and equity in a city currently focused on inequality and racism, but past and

current mobility options in Los Angeles are not obviously more fair or equitable than those being studied. We do not propose a particular form of congestion pricing nor suggest where it might be implemented. History demonstrates that dynamic road pricing is worthy of serious consideration because it complements earlier approaches to control traffic. Carefully implemented and informed by experiences long forgotten by many, it can enhance mobility for automobile and transit travelers, lessen the harm done to congested neighborhoods, and charge rich and poor people more fairly for their transportation regardless of their race or ethnicity.

Find a comprehensive timeline accompanying this report at the Luskin Center for History and Policy website, or at this link.

Introduction

> *"The alarming increase in street accidents and in street congestion during the past few years has rendered the correction of traffic conditions one of the most important municipal problems of the present day."*
> *Miller McClintock, 1925*[2]

Los Angeles is searching for new ways to address the region's persistent problem of recurring traffic congestion. More than forty cities abroad, including Oslo, Stockholm, Singapore, and London, have proven that congestion pricing facilitates movement and has the support of rich and poor residents. In 2019, the Board of Directors of the Los Angeles County Metropolitan Transportation Authority (Metro) approved studies to assess the feasibility of reducing traffic by charging different prices at different times and places for driving on streets and roads in Los Angeles. One month later, the Southern California Association of Governments (SCAG) released the results of its own long-term congestion pricing study. Five years of data collection and community engagement led SCAG to recommend a pilot project for West Los Angeles within a specific area they are calling the "GO Zone."

Controversy is sure to follow, for drivers will initially resent paying to use streets and roads that have long been free to them. They might also worry that road pricing will fail to function as promised, that trip times will remain unpredictable, or that pricing will be unfair to people with low incomes. COVID-19 adds to these concerns because public health authorities required the city and its economy to go into a partial "lockdown." Results included deep economic recession, growing numbers of evictions, unacceptable unemployment, and free-flowing traffic. From newspaper columns to television talk shows, media personalities have voiced amazement at the road conditions and wondered whether pre-COVID-19 city life can resume, but without the traffic. One writer in the *Los Angeles Times* likened this moment to Copenhagen in the 1970s, when rising oil prices led a wave of residents to adopt bicycle commuting. Here in the US, with streets so much less congested due to the pandemic, national bicycle ridership has risen 21%, and the author asked whether "some U.S. cities are on the brink of a Copenhagen remodel?"[3]

Congestion pricing, first proposed over a century ago, consists of variable charges levied on drivers in exchange for access to streets or roads at their times of peak usage. It prevents traffic jams by convincing drivers unwilling to pay a high rush hour toll to use another cheaper route, switch to transit, or postpose their trip to a cheaper time. Beyond a handful of toll roads in Orange County and High Occupancy Toll (HOT) lanes, Greater Los Angeles has rarely experimented with anything akin to congestion pricing. Local leaders since the 1920s have seen "congestion not as an excess of cars but as a scarcity of street space, to be remedied by the supply of street capacity."[4]

The solution to the problem, if framed this way, seems clear. To fix a street too often jammed with cars we widen it, build another street or road parallel to it, impose new rules to enforce efficient traffic flow, or to tell drivers when and where to avoid

congestion. Unfortunately, these solutions, all tried many times, have only delayed the recurrence of congestion. Economist Anthony Downs coined a Law of Peak-Hour Traffic Congestion: potential travelers will notice fluid traffic on previously clogged routes and then refill the road to its point of "maximum capacity."[5] This has come to be known as induced demand. In the forty cities that have congestion pricing, adjustable costs respond to consumer demand and reduce traffic, increasing the efficiency of movement by preventing drivers from overburdening road space.

Slow traffic scared officials in Greater Los Angeles regularly for a century. They seemed to think congestion might stop the city's proverbial heart. They were anxious that economic growth might cease and visitors might not return to the city recalling an awful experience. Committees in and outside of government were convened to make sense of this problem by gathering evidence and debating the next steps. A few themes dominated thinking about traffic reduction throughout the history of the city, and we present each of them in this review. The first theme was **land use planning**. Developers created a structurally decentralized city to escape from traffic, but with time, a New Urbanism promoting density to overcome traffic came into vogue. These two opposite visions for the city were each supposed to alleviate traffic. Neither worked. Another persistent theme was **roadway construction**. Los Angeles is famous for the results: wide boulevards and wide freeways where commuters could speed to work. Congestion endured. A third strategy was **traffic management**. A city traffic code gave priority in the streets to cars, trucks, buses, and motorcycles. A “freeway revolt” against huge and costly projects prompted traffic engineers to write new laws to modify driver behavior. **Land use regulation** was adopted to control the degree to which new housing and offices created new trips. Despite these efforts the streets remained clogged. Over time, the city turned to new **communications and information technology**. Authorities relayed updates about traffic conditions to drivers, and engineers adjusted synchronized systems of street light to optimize flows. Information technology was used to match travelers by their work locations and commute times so they could **share rides or replace work trips by telecommuting.** Even these cutting-edge innovations did not bring an end to recurring traffic jams.

We devote a section of this paper to each of these themes, examining its 100-year history in and around Los Angeles. This allows us to illustrate how authorities often revived the same traffic reduction tactics, from land use zoning in both the 1920s and 1960s and laws to modify driver behavior in the 1920s and 1980s. These long trends, demonstrate what author Norman Klein has said - that Los Angeles has a "history of forgetting." Policies of the past which did not work adequately - or at all – illustrate our short collective memory. At best, officials have convinced themselves that yesterday's failures might become today's successes because the city had changed dramatically in the time since.[6]

During the thirties engineers plotted freeway routes under the assumption the population growth of Los Angeles had steadied. They could not foresee the postwar boom in suburbanization that filled land tracts with young families driving multiple cars per household. New population overwhelmed transportation systems built for fewer drivers, and critics claimed, despite many prior plans, that Los Angeles was an outcome of unplanned sprawl. Erasing memories of past plans for traffic reduction in Los Angeles ensured that planners to come would not learn well enough from mistakes local

historians knew well.[7] That is precisely why this history must be central to current considerations of congestion pricing. The next six sections are histories of policy in practice. They demonstrate the repetition in each of the themes as Los Angeles confronted traffic over a century. Where possible, we document levels of congestion at different times, but doing so accurately is impossible. Over a century, data were collected using different methods in different communities having wildly different levels of precision or accuracy. We rely to a far greater extent on accounts of perceived levels of congestion and published plans to address it than on empirical measures of traffic flows at particular times and places.

To inform studies and a public debate about the possible future of congestion pricing in Los Angeles, we conclude with the history of congestion pricing as a policy intervention that has often been proposed but never adopted in Los Angeles. The technology to enable an efficient system of road charges did not exist during most of the time period we studied. Theorists developed models in anticipation of a time when vehicles would incorporate necessary communications capacities. Open the Lyft or Uber app on your smartphone and plot the same trip during rush hour and in the middle of the night, and see for yourself that we have the ability to price trips differently in real time depending on traffic. Massive retooling of all vehicles is not needed. Hand held transponders are widely used now. A Metro app installed on smartphones, would allow the agency to price trips to lower congestion, confirm which drivers are in carpools, and grant price reductions to vehicles carrying passengers with disabilities or having qualifying low incomes. An early version of road charging is already in effect on three facilities: Express Lanes on the Riverside Freeway (SR 91), the Harbor Freeway (I-110), and the San Bernardino Freeway (I-10). This paper shows how thinking about pricing has helped these three facilities work and addresses the potential of road pricing to be more broadly applied to benefit auto commuters and those traveling in buses on the same streets and roads.

People usually respond rationally to incentives and disincentives. Roads and transit are costly to provide, and we have paid for them indirectly through gasoline taxes and sales taxes while keeping the price to drive nearly zero. Policies like congestion pricing have the potential to rebalance the scales and give drivers incentives to consider carpooling, telework, public transit, bicycling, or living within walking distance to work and shops. In the meantime, congestion pricing along streets with bus lines and bicycling lanes promises more reliable scheduling to the transportation system's most vulnerable population: people without the capital or the ability to drive at all. In Los Angeles and Orange Counties 61% of people who use public transit have no cars available and their buses are slowed by streets crowded by cars.[8] Transit-dependent people have far lower incomes than typical drivers in Los Angeles yet we expect public transit to charge fares. If peak hour bus trips were not priced the vehicles might become so crowded that they would not function adequately for those making essential trips to work or school. Technological advances make it possible for the first time in a century to apply similar logic to roads and autos.

Measuring Congestion

What causes congestion?

Congestion occurs when the number of vehicles using a road exceeds its capacity… "Recurrent congestion" occurs because of work schedules, scheduled events, and regular hours of business operations.

"Episodic congestion" occurs because of unpredictable events including crashes, spilled truck loads, broken water mains, and construction projects. This type of congestion can appear at places and times that normally flow freely.[9]

Speed and Flow

When addressing congestion, we measure:

a) Speed: The distance covered by vehicles in a traffic stream per unit of time, commonly stated in miles per hour.

b) Density: The number of vehicles on a section of roadway. For example, the number of cars in a lane in one mile.

c) Flow: The number of vehicles passing a point in a unit of time. For example, the number of vehicles that drive past a marker on the road in a minute.

The relationship between these factors were developed by B.D. Greenshields in 1933. The shapes of Figures 1 and 2, while generated from real-world data, hold true across a variety of roadways.

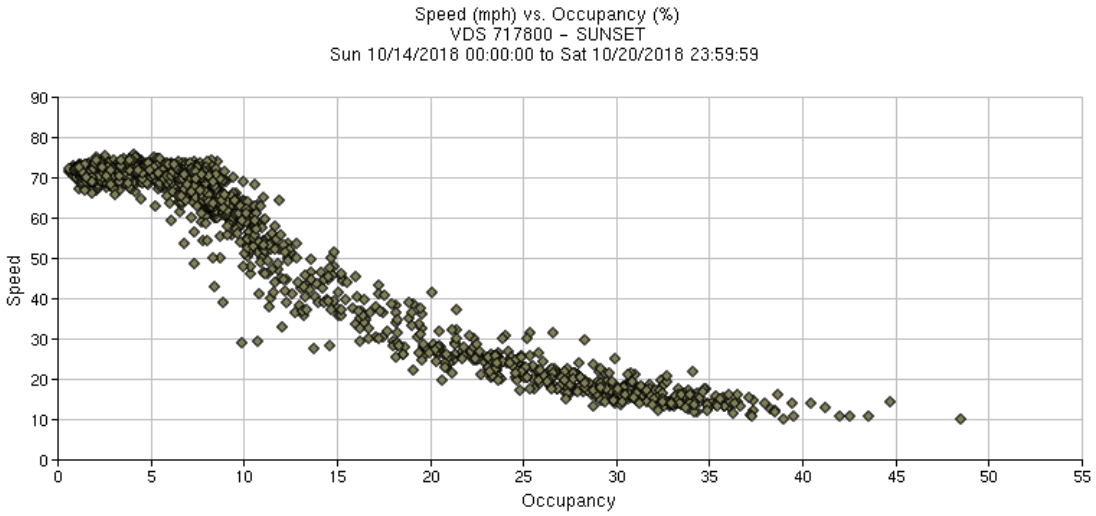

Figure 1**.** The relationship between speed and density. (Occupancy is a reliable proxy for density when traffic states are unchanging.)

This data, from Caltrans' Performance Measurement System (PeMS), shows data taken from part of the I-405 in 2018. The measure on the horizontal axis, occupancy, is a good estimate of density when traffic conditions are relatively unchanging.

As shown in Figure 1, cars are able to drive at high speeds when volume is far below capacity, since there are few other cars on the road. This is known as free-flow speed. As

more cars are added, this has only a small influence on the speed of travel. As cars continue to be added, speed begins to drop as the roadway becomes more crowded until traffic is at a standstill. The point marking the sharp decline in speed is the critical density. Figure 1 shows that:

1) When cars are traveling at free flow speed and more cars are added the flow increases.
2) Flow continues to increase until the critical density.
3) Every additional car now lowers speed on the roadway.
4) Since cars are traveling slowly when traffic is dense, fewer cars overall are passing a given point on the roadway.
5) The relationship between density of traffic and speed is non-linear.

Figure 2 shows the relationship between speed and flow. As described above, flow increases until the roadway reaches capacity then begins to decline.

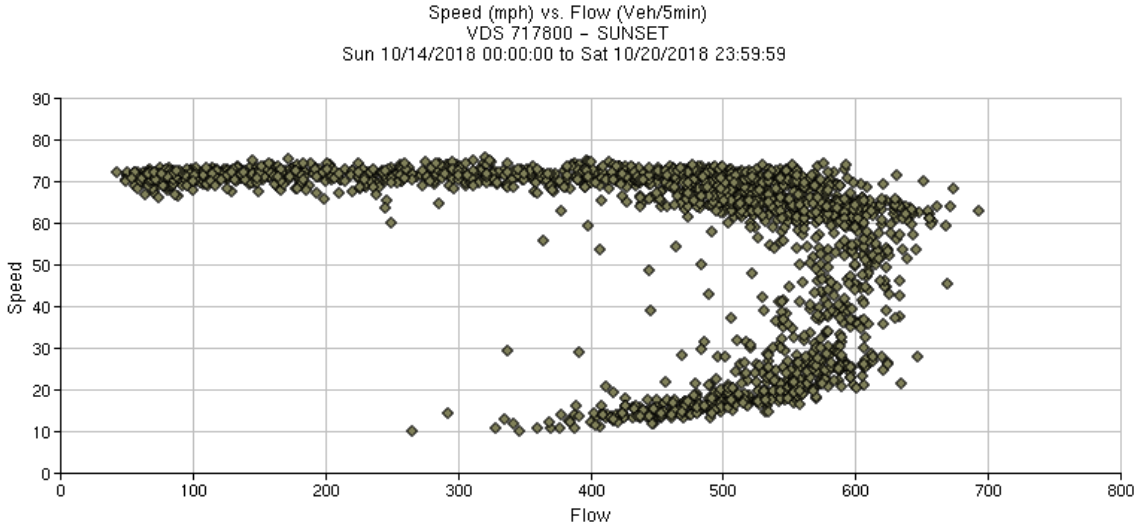

Figure 2. A diagram of the "backward bending" speed-flow relationship. Dots between the two "branches" of the curve indicate a measurement taken as the road became more or less congested. (Data points are averaged across five minute intervals.)

When relatively few cars are traveling, but each moves at high speed, the flow can be the same as when the road is crowded with many vehicles moving slowly. This diagram shows that near the roadway's capacity, only small changes in the overall demand on the roadway can greatly increase or decrease its speed. While specific numbers vary by roadway, this case illustrates the relationship just described: If 160 vehicles extend over a mile of roadway, and each is traveling at 5 miles per hour because the road is quite congested, then 800 vehicles are traveling over that roadway per hour. When the road is un-congested, the speed rises to 40 miles per hour. While there are only 20 vehicles per mile, the flow is also 800 vehicles per hour.

Figure 3. Photograph of Fletcher Drive and the Pacific Electric bridge by Herman Schulteis, ca. 1938

Land Use, Rapid Transit, Density, and Traffic

> *"Great as has been the increase in population, buildings and property values, vehicular traffic has increased even faster."*
> *Frederick Law Olmsted, Harland Bartholomew, and Charles Henry Cheney, 1924*[10]

Los Angeles is said to have heavy traffic because of what many call its "car culture." People in this region are believed to own more cars, love them, and drive them more than people in most other places. That belief is mistaken. America is auto dependent and Los Angeles is not unusual. Car ownership in Los Angeles, about 1.8 cars per household, is about the same as ownership rates in Seattle and Cincinnati,[11] cities not thought to be especially car oriented. According to the Federal Highway Administration, residents of the Los Angeles-Long Beach-Anaheim Urbanized Area drive about 22.3 miles per capita per day, about the same amount of daily travel as people living in Akron, Ohio, and half as much per day as those in Beaumont, Texas.[12] Akron and Beaumont are not known all over the world for their traffic congestion.

Furthermore, Los Angeles' transit ridership is third among all cities in the nation behind New York and Chicago[13]. While there would be many benefits to increasing transit use here, doing so would not eliminate congestion. Blaming congestion in Los Angeles on a love of cars ignores the fact that large cities all over the world experienced traffic congestion for centuries even before the automobile was invented.

Traffic congestion in Los Angeles reflects the city's development patterns which influence travel to a greater extent than car ownership and use. People travel between homes, jobs, schools and shopping centers. The location and density of those activities determines the number of trips made and the lengths of trips. A study by the RAND Corporation concluded that Los Angeles stands out among U.S. cities by being both one of the most densely populated and one of the least centralized.[14] Its large population and successful economy lead to many trips, but its "polycentricity"– the dispersion of centers of activity rather than a single, concentrated downtown – means those trips are both long and difficult to serve by rapid transit. Ironically, the dense yet decentralized L.A. metropolitan area was created by past programs and projects intended to support public transit and cope with traffic. As Los Angeles grew, real estate developers, reformers, and politicians wanted to enable families to escape from downtown congestion by encouraging suburban decentralization. Others, often at the very same time, sought to counter traffic resulting from "urban sprawl" by encouraging centralization and increased density. A century of promoting decentralization and centralization to fight traffic has made Los Angeles a city of "dense sprawl."[15] The debate between concentration and spreading of development continues without resolution today. Its century-long history demonstrates that adjusting the patterns of incremental or new urban development cannot alone resolve traffic congestion in what is now a large metropolis that can change only very gradually.[16] Los Angeles grew most dramatically as its transportation system experienced rapid evolution. In 1870, the county's small town population of 5,000 people relied on horses to power wagons and streetcars. By 1910, its burgeoning urban population of 320,000 moved about in cable cars, electric streetcars, the first automobiles, and early buses. Land developers, exemplified by railroad heir Henry Huntington, made vast fortunes buying land outside the center of town, building rail lines to it, and selling lots for homes and businesses away from the crowding and horse-


To persons looking for either an

INVESTMENT OR A HOME,

WE COMMEND THIS PROPERTY.

Two Years' Credit!

TITLE PERFECT.

These Building Sites have advantages over other property in the city of Los Angeles

ON THE HILLS!

AWAY FROM FLOODS!

Only Nine Minutes from the Heart of the City.

TWO CABLE RAILROADS RUNNING DIRECT.

Do not fail to examine this beautiful property before the day of sale, and remember

THE SALE IS POSITIVE.

(SEE MAP INSIDE.)

Sale to be held on the Grounds,

FRIDAY, MAY 14th, 1886,

At 11 o'clock, A. M.

Figure 4. Advertisement for land subdivision in Los Angeles, illustrating the prominence of railway access in the promotion of real estate.

pollution of downtown yet accessible by streetcar to its business and cultural attractions. Life in outlying areas was advertised as idyllic and appealing to families seeking the healthful fresh air. As small, dispersed communities near transit stops grew larger and spaces between them filled in, growing auto travel produced persistent traffic congestion.[17] Low density development, facilitated by investments in transit, encouraged families to buy automobiles that clogged the streets as their numbers grew. Auto registrations in Los Angeles County increased tenfold in the ten years between 1914 and 1924, from 50,000 to half a million.[18] Service on rail lines, located in the streets, slowed as their tracks were overrun by cars, so people bought more cars to escape the increasing unreliability of the transit service. Many of the inequities we observe in the region's settlement patterns began to take shape as people of means, mostly white, moved to suburbs and poorer people, including many members of minority groups, remained in more crowded downtown locations. Rich car owners complained of congestion that clogged streets in poorer urban neighborhoods.

> *Humanity demands that man should have sunlight, fresh air, the sight of grass and trees. It demands these things for the man himself, and it demands them still more urgently for his wife and children. No child has a fair chance in the world who is condemned to grow up in the dirt and confinement, the dreariness, ugliness, and vice of the poorer quarter of a great city. . . There is, then, a permanent conflict between the needs of industry and the needs of humanity. Industry says men must aggregate. Humanity says they must not, or if they must, let it be only during working hours and let the necessity not extend to their wives and children. It is the office of the city railways to reconcile these conflicting requirements.*
>
> Charles Horton Cooley, *A Theory of Transportation,* Publications of the American Economics Association, 1894

In 1924 the city council and the county board of supervisors agreed to share the cost of hiring a firm of experts to prepare a comprehensive transit plan for Los Angeles. The Chicago firm of Kelker, DeLeuw, and Company in 1925 submitted the *Report and Recommendations on a Comprehensive Rapid Transit Plan for the City of Los Angeles*. The plan called for the construction of 26.1 miles of subways and 85.3 miles of elevated railways during the next ten years and proposed many miles of feeder bus lines and bus routes in outlying areas.[19] Reflecting growing regional rejection of centralization and growing distrust of "downtown" interests, C.A. Dykstra in a 1926 essay refuted the report's suggestions, associating rapid transit with the centralization of the city's development. Transit had played the leading role in spreading the city out, but its high capacity to move people came to be seen as essential to strengthening downtown businesses. Dykstra, the future City Manager of Cincinnati and later UCLA Provost, asked "why begin, particularly if there is adequate territory to care for a constantly growing population." Dykstra believed Los Angeles could best address its traffic congestion problem through the development of low-density neighborhoods, in his words, "beyond its frontiers."[20]

Zoning came into being in the twenties, playing an important supporting role by reinforcing the emerging dominance of the multi-centric city. The power to create

zoning ordinances was granted by the state to municipal governments, weakening the power of county authorities to control development patterns in incorporated areas. Zoning in outlying communities limited residential and commercial building heights and densities. By requiring as many as two or three parking spaces in each new dwelling and a parking space per employee in businesses, zoning simultaneously lowered the density of communities and created incentives to depend on autos by offering free off-street parking at most locations.[21]

Though the regional rail network had failed to obtain voter support in the 1920s and decentralization accelerated as the city grew, the hope of concentrating development at greater density around public transit never died and remains alive today. The Los Angeles Chamber of Commerce vigorously promoted an underground and elevated rail transit system soon after traffic resumed its unrelenting growth in the wake of the Great Depression and World War II. Voters defeated a 1948 initiative the Chamber called "Rail Rapid Transit Now" even though its supporters claimed that traffic would soon strangle the city unless it was approved.[22] Voters living in the San Fernando Valley saw no need to tax themselves to bring business to downtown land owners.[23] The Los Angeles Chamber, committed to a Los Angeles with a dense, concentrated urban core, continued to favor mass rapid transit when it announced a new ten-year plan called *Destination '70* in May 1961. The Chamber's Transit and Traffic Committee promoted mass transit as a means of slowing growth in traffic congestion because it provided the "only alternative to driving." In the run-up to the November 1968 elections, the Chamber acknowledged that freeways alone were not enough to manage traffic, associated freeways with low density sprawl, and argued that "a major supplementary and complementary system of mass transportation must be built as soon as possible." To fund the $2.5 billion plan to build eighty-nine miles of rail, Proposition A proposed a half-cent hike to the local sales tax. Even a vast coalition, featuring vocal support from the mayor and Governor Ronald Reagan, could not get the historically anti-tax and largely suburban population to vote "yes."[24] The Chamber of Commerce was widely perceived to be promoting its own interest by facilitating permanent downtown growth and regional dominance at the expense of the county's strong and growing suburbs.

After this setback, City Planning Director Calvin Hamilton cast the contrast between long-competing visions of Los Angeles in stark relief as a denser, downtown and transit-oriented, traditional city versus the unique suburban paradise now straining under continued growth. His visionary 1970 plan called *Concept, Los Angeles*, proposed an urban form that was a compromise between the two poles and addressed popular concerns about worsening traffic congestion. A spatial mismatch between government, business, and financial offices concentrated at the core and commercial services in the suburbs would require more commuters to take long trips, but they would be served by transit links and freeways connecting the centers. Travel appropriate to L.A.'s unique form meant that an

> …increased number of automobiles operated by the growing population will require the continuous addition of freeways, major highways, local streets and parking lots, just to keep congestion from getting worse. More and more land will be used for street purposes and will be removed from

> the tax rolls…buses will compete with automobiles for space on the City's crowded streets and freeways.

Concluding with a few lines about the worsening air pollution that was becoming a vexing regional challenge, the report acknowledged that traffic was far more than a mere annoyance. Congestion had the potential to decimate the city's revenue, disrupt surface public transportation, and do great harm to the health of its residents and the beauty of its environment. The root of the problem and the source of its solution was to be found in the rearrangement of activities in space linked by fast, high-capacity transportation.[25]

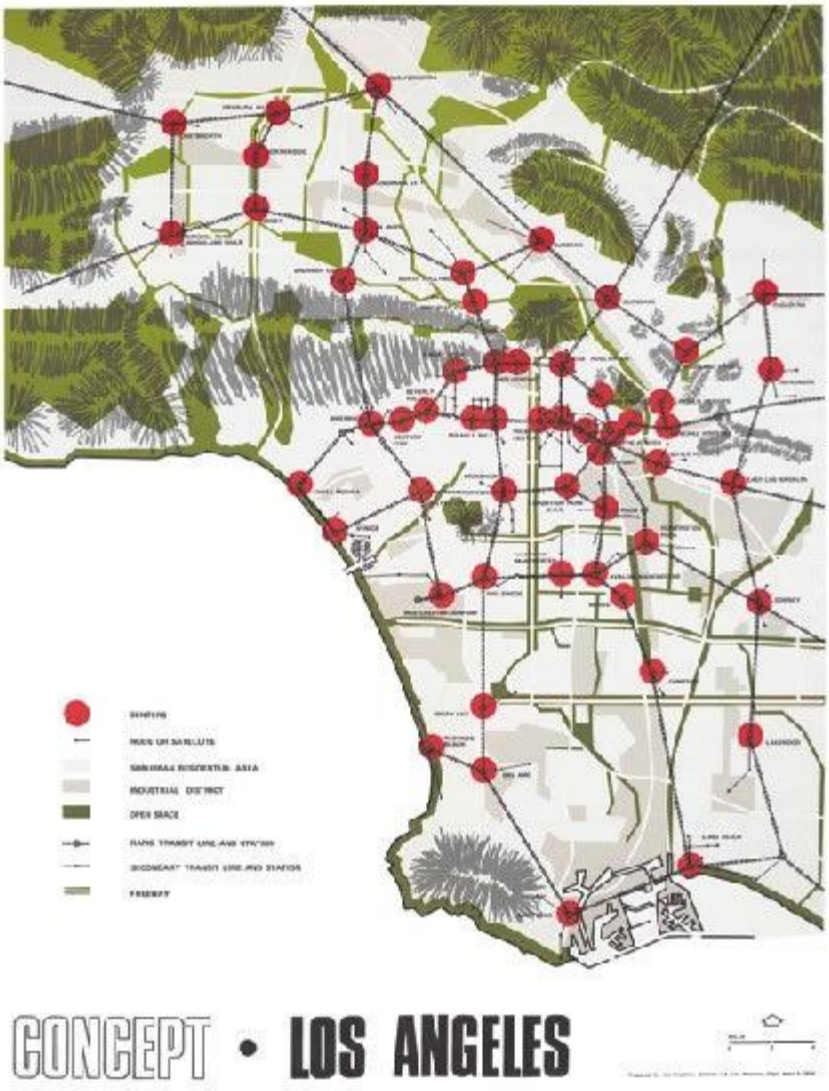

Figure 5. Regional Centers and Transit Blueprint from the Concept Los Angeles General Plan

The solution Hamilton offered was the concentration of economic and political functions into dozens of high-density "centers" throughout the region. Linked by both freeways and rapid transit facilities, the dispersed but dense centers would be

surrounded by low-density neighborhoods of single-family homes. The concentrated yet dispersed nuclei would help reduce traffic congestion. Residents of suburban low density areas would drive to "park and ride" lots in the centers where they would board rapid transit that operated on "separate rights-of-way" to reach other centers, including, but not only, downtown. His plan also called for placing freight railroads from the ports below street level and designating "truck routes" on some freeways. The report predicted optimistically that "Peak-hour congestion on major suburban streets will be substantially alleviated by the diversion of commuting traffic to the rapid transit system." Even though most of the designated centers already existed, Hamilton's plan never came close to completion. As a compromise between concentration and dispersion, it perfectly reflected the region's persistent indecision.[26]

Yet another ballot measure that would have supported construction of a rail rapid transit "starter line" failed to win voter support in 1974. This proposal concentrated rail investments in downtown and the Wilshire Corridor to the west and, yet again, faced opposition from outlying communities which opposed central city interests. Given these repeated failures at the hands of suburban voters' skepticism over the benefits of increased taxes to pay for rail transit, maverick Democratic County Supervisor Baxter Ward argued that a decentralized regional transit network was a better match to the region's needs. In 1976 Ward spearheaded two ballot measures – Measures R and T for "rapid" and "transit - to increase the sales tax in order to build and operate the *Sunset Coast Line,* a light rail network to be located mostly in the median strips of freeways and on abandoned former rail lines. His twin measures, one to approve the concept and one to raise the revenue, both failed badly, after being vigorously opposed as inadequate by both downtown interests and still skeptical suburban opponents. [27]

Reeling, but learning, from repeated voter rejections, Los Angeles finally acquired revenue needed to begin constructing a regional rail rapid transit system when voters at last approved a half-cent sales tax in 1980. Designed, like Calvin Hamilton's plan, in recognition of the regional tensions between centralization and decentralization, the measure ingeniously committed a portion of the tax revenue to a regional rail network but also funded bus operations throughout the county and provided for freeway improvements. Key to its success was the inclusion in the measure of money in the form of "local return" to every city in the county to repair its local streets and roads and/or operate its own bus system. All local governments had suffered dramatic property tax losses following the passage of Proposition 13 in 1978, so they supported the measure primarily to get their share of the revenue, and the adoption of a regional rail system came with it.[28] Three more half-cent sales taxes, following the model of providing "something for everybody" were approved by L.A. County voters in 1990, 2008, and 2016. Each imitated Proposition A by combining investments in a regional rail system with local and decentralized transportation funding.[29] The still developing regional rail network eventually will link many communities that would have been served by the 1924 and 1948 proposals and will connect many of the centers named in Calvin Hamilton's plan. Today, planners and advocacy groups continue to promote concentration, arguing that public transit reduces traffic growth by encouraging high-density mixed-use development near station sites, but there continues to be vocal opposition as well.

In 1988, the Southern California Association of Governments added a new dimension to the discussion of urban form and traffic. SCAG published a study arguing

that building more lanes or levels of traffic would not ease congestion as much as would increasing the region's "jobs-housing balance" to encourage commuters to reside closer to where they worked and shopped.[30]

Echoing observations that earlier had led Calvin Hamilton to propose the Centers plan, it was noted that many suburbs in the Los Angeles region were primarily bedroom communities while others were primarily job centers. Throughout the eighties SCAG's regional plans increasingly asserted that the region would become more efficient if future jobs were to be located near existing housing and new housing concentrated closer to centers of employment. Jobs-housing balance was promoted to increase economic opportunity, promote efficiency and equity, and reduce traffic by shortening work trips.[31] Many communities strived to increase their jobs-housing balance, and quite a few, like Santa Monica, have done so, but there is little evidence that more "balanced" communities have reduced congestion in comparison with less balanced ones. New housing units may not meet the needs or suit the budgets of people working near them. Many households include multiple workers, so living near the work location of one family member may lengthen the commute distance of another. Work trips account for less than a fifth of all household trips and workers choose their residential locations based on many criteria in addition to proximity to work, such as the quality of schools and proximity to recreational opportunities.[32]

The long struggle to define the future of Los Angeles continues. Many advocate the New Urbanism and transit-oriented communities, while other groups in Los Angeles are equally committed to slowing the growth in development density that enables that vision to be attained. For the sake of reducing traffic congestion, community and homeowners' organizations repeatedly have fought proposed changes in zoning and developments intended to create higher density mixed use centers that support rail transit, on the grounds that traffic congestion will inevitably worsen if density rises.[33] In the next section we review efforts to address growth in traffic congestion by increasing street and road capacity, including an enormous commitment to freeway building that changed the nature of Los Angeles in many ways. After reviewing commitments to enhancing capacity, we also will examine the region's ongoing efforts to manage congestion by regulating the use of streets, highways and vehicles. Because an important component of efforts to address traffic through regulation entail the regulation of land use, we will revisit the theme of urban form in relation to traffic as well.

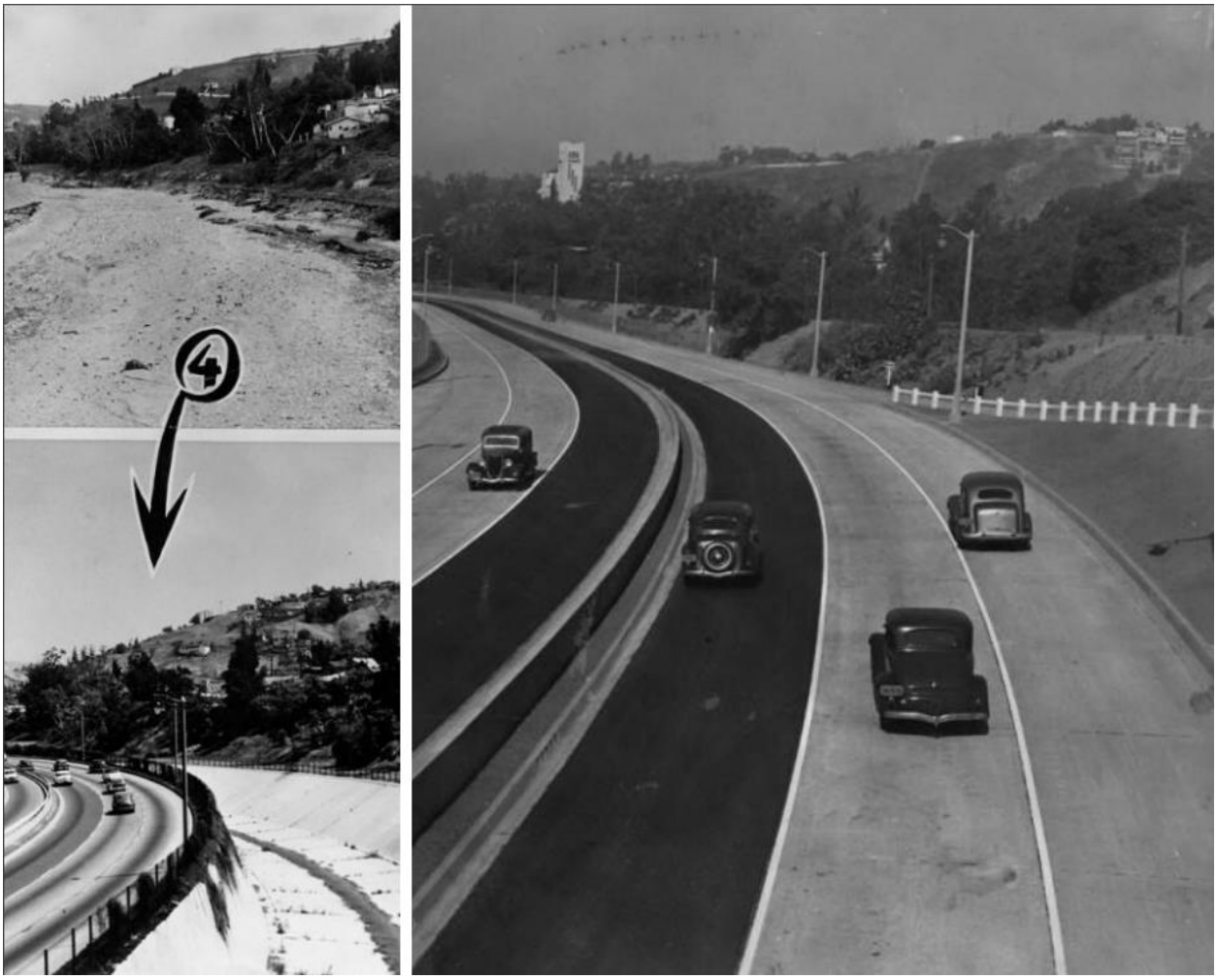

Figure 6. Left image is Arroyo Seco Parkway, then and now, 1955. Right image is Arroyo Seco Parkway as it opened, 1940.

More Space for Driving: Constructing Highways and Freeways

> *"All authorities agree that the congestion is primarily caused by insufficient street area. This is readily apparent when figures are consulted and Los Angeles is shown to have the smallest percentage of street area of any of the large cities of America."*
> *Los Angeles Traffic Commission, 1922*[34]

As the century-long disagreement about relationships between transit and urban form went on, Los Angeles continually expanded roadway capacity in the pursuit of congestion relief. The broad parallel boulevards west of downtown were intended to end congestion as the city expanded toward the ocean in the 1920s. Between the 1930s and

the1980s freeways greatly multiplied the region's capacity to move cars and trucks. They relocated and disrupted the lives of hundreds of thousands of families, eliminated entire communities, concentrated motor vehicle emissions in other, mostly minority communities, but were deemed "necessary" because of the congestion relief provided by more roadway space, grade separation, and limited on and off ramps. Today, most drivers in L.A. know that relief from congestion by building freeways was short lived.

J.B. Lippincott was known for the role he played in building a mammoth aqueduct from the Owens Valley to Los Angeles. Having left the Interior Department to serve as traffic engineer for the Automobile Club of Southern California, he conducted "the most complete study of traffic conditions ever made in the West" according to the club's magazine, *Touring Topics*, which reported the results in 1920. Engineers interpreted traffic flows on their maps as a call from drivers for expanded infrastructure. Careful observations of 15 busy intersections between Los Angeles and surrounding cities "proved" that the major culprit for congestion was not automobiles traveling from one side of the city to the other through downtown, but rather the suburban commuters who drove daily into the city. Stressing that a disproportionate number of drivers began their journeys in Glendale, Eagle Rock, and Pasadena and then became trapped at the city's northeastern Pasadena Avenue-Avenue 20 intersection, Lippincott recommended building an alternative route "through or around Elysian Park."[35] His traffic survey became the inspiration for the Figueroa Tunnels, completed in 1931, later incorporated into the Arroyo Seco Parkway.

Before 1920, the Automobile Club, the Business Men's Cooperative Association, officers of the Pacific Electric Railway, and members of the city council all had addressed traffic, concluding that Los Angeles had severe congestion primarily because it had an inadequate street system. Proponents pointed out that Washington, D.C., at the time devoted 44 percent of its central city area to streets and San Diego's downtown devoted 41 percent of its area to streets, while Los Angeles' central area had narrow and discontinuous streets amounting to a mere 21.5 percent of its total downtown land area. Widening and extending streets would help automobile and transit commuters alike, argued the Traffic Committee of the Chamber of Commerce, since both modes shared the streets.[36]

Such thinking led Los Angeles to commission several surveys, the most notable leading to *A Major Traffic Street Plan* in 1924. Expert designers came from the east and mid-west to diagnose the "traffic congestion problem" in Los Angeles as the worst in the U.S. They identified a downtown "congested district" and recommended fixing it by expanding and improving the supply of street space radiating outward. The most expensive highway projects of the 1920s were bridges over the Los Angeles River into East Los Angeles. During this period, traffic commissioner Miller McClintock, decried Los Angeles for its "unscientific width and arrangement of streets."[37] Historian Peter Norton traced the evolution of McClintock's thinking from a time when he thought "widening streets would merely attract more vehicles" to favoring more street capacity. Automobile companies seeking to increase car sales paid experts to do studies that, not surprisingly, concluded cities needed to provide their inhabitants more street space to accommodate more vehicles. After auto manufacturer Studebaker funded McClintock's traffic research institute at the Southern Branch of the University of California, later

known as UCLA, his outlook evolved, and he began asserting a newfound belief in "the inevitable necessity to provide more room" for the coming flood of cars.[38]

Figure 7. Figueroa Street Tunnels before completion of the Arroyo Seco Freeway

Traffic engineers, like water engineers, saw congestion like the problem of flooding, and the projects they proposed for speeding traffic even overlapped at times with flood control infrastructure. The first freeway in Los Angeles, the Arroyo Seco Parkway – a road in a wide landscaped right-of-way that later was renamed the Pasadena Freeway, before returning to its original name, ran parallel to a runoff channel until it bypassed the bottleneck Auto Club surveyors had identified just north of downtown and coursed into the Figueroa Tunnels. Along the route, drivers were to enjoy the view of beautiful open space. Long before the first freeway's 1940 completion, the director of the California Real Estate Association made a case for its construction to the *Los Angeles Times* in 1931. He heralded "traffic arteries free from crossings at grade," which "would tremendously speed up that traffic which seeks to proceed from the coast to the interior valleys." The label "freeway" was derived from this description.

By 1937, a commitment to increasing street capacity was made in the Auto Club Engineering Department's *Traffic Survey: Los Angeles Metropolitan Area*. A club officer wrote an introductory letter explaining that the city's "growing congestion…is the direct result of an attempt to serve both abutting property and through traffic upon the same street or highway." Los Angeles needed not only more roads but ones next to vacant strips of land, which we now call shoulders. The *Survey* blamed roadside development, which "directly or indirectly retards the movement of vehicles," by encouraging drivers to stop. The club asked the public sector to assume responsibility for land government should purchase to keep it free of commercial development or housing. Auto Club engineer E.E. East later sharpened the criticism of roadside

entrepreneurs who exacerbated congestion in an essay for *Los Angeles: Preface to a Master Plan*. East believed that "business owners demand signals to slow traffic past their door," for "[t]hey see new, heavy investments jeopardized because traffic moves too quickly to their downtown competitors."[39]

An opportunity for the government to expand Los Angeles' transportation network and accelerate the speed of traffic arrived when the war economy coincided with the New Deal of the 1940s. *Freeways for the Region* was published in 1943 by the Los Angeles County Regional Planning Commission. From an article calling it "A Master Freeway Plan for Los Angeles," readers learned what this new space exclusively for automobile driving would be like. The *Times* foretold "the unkinking of no-longer-tolerable traffic snarls in many parts of the city and its metropolitan environs," and the report promised that experts would "search for routes in position to give relief to areas where the greatest need existed prior to 1942, the last date for which normal traffic data are available." The streets had grown more congested in new industrial suburbs where wartime aircraft production had boomed. Maps showed where congestion had worsened, and those areas became priorities for freeway access. Two examples were the San Fernando Valley neighborhood to the northwest of downtown and the southeastern corridor passing through Downey, homes respectively to Lockheed and Vultee Aircraft, two huge wartime employers.[40]

The framers of *Freeways for the Region* favored building "facilities which are deliberately designed for the decentralized community, but that design does not need to increase the destructive aspects of decentralization." Drivers could in the future choose from a variety of routes the type of road most suitable to their trip. Freeways would serve drivers seeking to go as far and as fast as possible with few distractions. The report even called for a ban on billboards facing freeways because they would distract drivers' attention. Drivers could turn onto local streets when seeking places to shop or to stop for a social call. The plan did not claim to bring an end to congestion, however. It acknowledged the limitations of freeways, predicting that even these routes would eventually become congested. "The time gained on the freeway would be lost in the greater congestion produced within the business district. One can even imagine cars 'backing up' on the freeway itself and interrupting the constant flow of traffic." If the County's population growth stabilized at six million, the planners thought the region might avert such a dismal future.[41] Only some of the proposed freeways were built and the current county population exceeds ten million people, so today's congestion was well within their sight.

To accommodate increasing popular demand for highway capacity, the federal Bureau of Public Roads developed a "traffic-service" model to predict where heavy traffic flows were likely to occur. Using tools developed in the interwar period, in what might be termed the golden age of traffic surveying, "origin-destination" data were gathered from randomly sampled motorists and plotted on maps of metropolitan areas like Los Angeles. They provided planners and engineers with "desire-line maps" that connected areas having the largest number of trip origins with the most frequent destinations. Lines on maps connecting popular origins with common destinations suggested where road capacity could most directly benefit drivers, but largely failed to analyze the communities they crossed or consult with their residents. Passage of the Federal-Aid Highway Act of 1944 initiated three years of postwar recovery spending on

roads. A quarter of the new funding was earmarked for urban routes and Los Angeles received its share. Almost ten years later, a planner from California could look back with pride and see "the wisdom of local planning agencies in anticipating a complete network of freeways to adequately serve the tremendous desire for motor vehicle travel in the Los Angeles Metropolitan Area."[42]

Planning for high capacity long-distance roads advanced with the Collier-Burns Highway Act of 1947, which committed fuel tax revenue to the building of rural roads and urban freeways. More driving increased fuel purchases which in turn funded more road construction that enabled more driving. This model for funding and administering roadwork later served as a "template for the 1956 federal legislation," which funded the U.S. Interstate Highway System. Motor fuel taxes were user fees akin to tolls, though less costly to collect, securing for states the resources needed to pay an enormous workforce to build this infrastructure. In exchange for accepting federal and state money, metropolitan leadership agreed to accept state and federal design standards. Reflective of rural highways, required designs implemented by state engineers rather than local officials prioritized traffic efficiency, driver safety, speed, and saving money on land purchases. Many Los Angeles freeways cut wide and straight or gently curving paths through a number of the city's lowest-income areas. Serving high volumes of trips to downtown led to building high densities of freeways closer to downtown just as the spokes of a wheel become denser near the hub. Inner city homes and workplaces belonging to members of blue collar communities disappeared after experts assessed their land as having low cost and remade it into space for driving.[43]

Highway construction and community destruction accelerated through the 1960s, when more miles were under construction than at any time before or since.[44] In the 1970s, clashes now known as "freeway revolts" arose as urban and suburban neighborhood groups organized in opposition to freeway building in their communities. Community activists, homeowners' associations, environmentalists and preservationists joined forces, fighting freeways for different reasons. Freeway building required considerable use of eminent domain and demolition, especially harmful in neighborhoods of color. Preservationists committed to the protection of the city's remaining historical districts, beloved parks, and open spaces with sensitive ecosystems were joined by the few communities of color that remained undisturbed..[45] Route 2, the Beverly Hills Freeway, for example, was cancelled after opposition grew among disparate groups along its entire route, from Silver Lake to Century City. Some entire future routes were deleted from official maps of the planned freeway system in the face of a burgeoning social movement opposed to the destruction of neighborhoods to improve traffic flow by expanding road capacity. In less than a quarter century– the time it takes to design a freeway, acquire property, clear its path, and build it – perceptions of freeways had evolved from the belief that they provided needed capacity to satisfy travel demand to condemning them as intrusions creating the traffic themselves.

Inducing Demand with Improved Capacity

New or improved traffic routes suffer from what has been described as a "triple convergence," by economist Anthony Downs in his book *Still Stuck in Traffic*. When traveling, most people want to minimize their travel time. If a congested route is widened, travel time decreases. People who formerly used alternatives converge onto the improved route. Other people who travelled before or after the most congested time period to avoid delays also switch onto that route, and the times at which they travel converge. Because travel times have decreased, some people who used other travel modes, like public transit, switch to cars. More drivers use the route, until they cause traffic to move more slowly, eliminating the advantage provided by the new capacity. Drivers then switch off the newly expanded route onto parallel routes or onto transit or they change their departure times until the travel time between the new route and its alternatives is roughly the same and there is no benefit to choosing a particular route or its alternative. When no route confers a particular time advantage, all routes are likely congested or circuitous.[46] In London, surface street traffic moved at the speed that a century ago made journey times roughly equal by car and by underground, and that remains true today.[47] In Los Angeles, many have noted that after a project to widen I-405 through Sepulveda Pass that took years to complete, traffic seems as congested as it did prior to undertaking that project, though the widened route was to service a larger number of travelers.

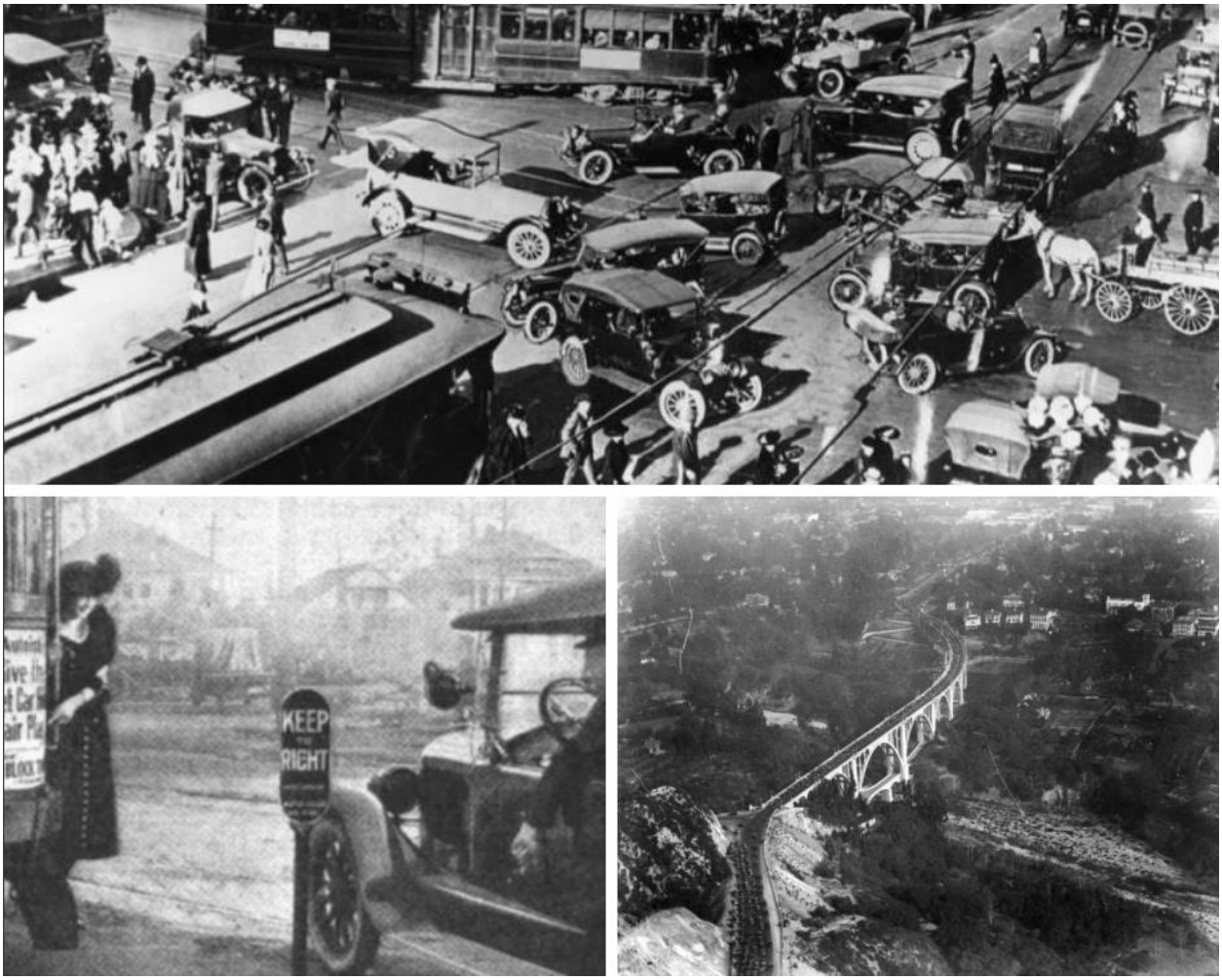

Figure 8. Top: 7th Street and Broadway; Lower Left, The placard reads "Mr. Autoist: Give the Street Car Riders Fair Play -Please don't Block Traffic -Thanks!";Bottom Right: Colorado Street Bridge, n.d., item 35323, Security Pacific, L.A. Public Library.[48]

Legislating Traffic by Regulating Driving

> *"The Council shall, by ordinance, within ninety days after this charter becomes effective, provide for the study of the problems of street traffic and for the recommendation of rules and regulations in relation thereto."*
> *L.A. City Charter, Article III, Sec. 36, 1924 (Repealed 1953)*

Los Angeles streets in 1900 were home to a chaotic mix of rapidly evolving motor cars competing for space with pedestrians, bicycles, 8000 horses drawing carts,[49] and

streetcars running on tracks in the middle of major streets. An outcome of this unruly multimodality was congestion. City planners and traffic engineers tried valiantly to craft rules balancing the rights to the city for these diverse modes, but never succeeded. Participating in what historians have called this period's "search for order," experts believed they could reconstruct U.S. urban life to become more "functional [and] efficient."[50] Government regulations seemed to be solving the paradoxes of capitalism, so why not bring a similar outlook to shepherding traffic on city streets? Deciding that the purpose of the street was to facilitate fast and efficient movement of the greatest number of people and goods through the city, experts began study of traffic scientifically to determine who deserved a share of the limited street space and who did not.

Even before traffic science emerged, business leaders in Los Angeles identified one type of vehicle they believed deserved no such space: "jitneys." In the summer of 1914, growing numbers of motor car owners began cruising the streets in search of paying riders as unlicensed cabs and informal buses. Charging five cents - the coin now known as a nickel was then also called a "jitney" - these micro entrepreneurs sought clients who might otherwise have paid that amount to ride a streetcar. City officials debated this business, but from the beginning, an anti-jitney consensus of elites emerged among those quoted in the *Los Angeles Times*. One angry tirade after another described drivers as "cheapening" streets with ill-maintained and poorly-operated vehicles. An affront to the interurban rail lines, jitney drivers diverted customers and revenues from transportation companies like the Los Angeles Railway and the Pacific Electric Railway, which had paid the city for franchises and had mostly loyal support from elected officials and business leaders. The most common complaint about the jitneys was that they exacerbated downtown congestion. Jitney operations peaked during afternoon rush hours, when drivers cruised for fares and stopped abruptly to pick up or drop off passengers, causing streetcar service to fall behind schedule. City officials reacted by requiring licensing, for which drivers had to pay expensive fees and to purchase insurance, and setting schedules, which forced jitneys to drive less flexible routes. The industry lost its competitive advantage and soon mostly disappeared.[51]

The Los Angeles parking ban of 1920 reflected the emergence of traffic science. Streetcar companies continued to fall behind schedule so the government, again demonstrating its support for the street railways, enacted a total ban on daytime parking in the city's congested core district. The Los Angeles Railway and Pacific Electric improved service reliability for a time, but irate motorists soon staged a revolt against the ban. In a mass act of civil disobedience, a caravan of drivers came downtown and blocked the streets. Three days after the parade, the city council rescinded the parking ban. The interests of motorists who wanted automobile access to a popular commercial area superseded those of transit riders who were now less likely to arrive at work on time. For the holiday shopping season of 1921, Los Angeles introduced a partial parking ban. Restrictions along designated arterials went into effect only during rush hours. By 1937, the city had pioneered a system of year-round afternoon parking bans for designated downtown streets. Drivers risked a ticket if they left cars on those streets before 9 A.M. or after 4:30 P.M. A writer for the United States Chamber of Commerce, looking back from 1954, heralded the city's parking policies as a nationwide model for "how to get the most out of our streets."[52]

The year 1924 was one of scientific discourse of traffic regulation. A Harvard University Ph.D. student introduced in an earlier section of this report, Miller McClintock, conducted fieldwork in Los Angeles as he completed his dissertation on traffic. A year before finishing, McClintock took three months off to consult for the city during which he wrote a model *Traffic Ordinance* intended to "remedy" mounting congestion problems. New rules restricted how those using various modes of transportation were to operate in the street. Prohibited during the day were freight vehicles of a large size and "the horse-drawn vehicle," which McClintock stated "reduces the speed of practically all following motor vehicles to its own gait." He called for an elaborate system of tunnels and raised platforms to steer pedestrians off streets and stricter police enforcement to force "obedience of pedestrians to signals." The code carefully mapped a "central traffic district" within which drivers were not permitted certain maneuvers that he claimed worsened traffic conditions. During the day, except on Sundays, drivers were not to turn left, which McClintock called a "principal congesting factor," nor to make U-turns. However, the code made it legal for drivers to turn right against a red light in order to keep traffic flowing.[53]

Consultants from Kelker, DeLeuw and Company of Chicago had advised the city to reorganize its dated public transportation system, but civic leaders decided, as noted earlier, not to take this route. In opposition to plans to build an underground subway for the city's core district, Los Angeles City Club secretary C.A. Dykstra predicted that added transit capacity would only make the core denser and more congested. He continued, "even if none but private cars and trucks should be allowed to use the streets our vehicular congestion would be as great as it now is. Downtown streets will no doubt always be used to their maximum capacity." Writing in the *National Municipal Review*, a magazine published on behalf of the National Municipal League (an umbrella organization for civic reform groups), Dykstra prefigured in print what was later called induced demand or latent demand when he explained, "Downtown streets no matter what their width probably will always be used to their capacity, for traffic will increase to the saturation point no matter what facilities are provided." Instead of building additional facilities, the city needed to admit "our vehicular congestion can only be solved by traffic regulation." Dykstra wrote the introduction to *Los Angeles: Preface to a Master Plan* (1941) where he made an exception for freeways because they were "devised to relieve congestion."[54]

To keep traffic flowing on freeways, officials over each decade devised a number of systematic regulations. One fanciful idea proposed in 1966 California was a law promoted by California Republican Caspar Weinberger (who later served as U.S. Secretary of Defense) to set minimum speed limits. He claimed "slow drivers" endangered others who got "backed up behind the lane hog."[55] Better known was the later effort to designate leftmost "Diamond" lanes for high-occupancy vehicles (HOV). Transportation engineering consultant John W. Billheimer documented the successes and failures of this experiment, the first of its kind to repurpose existing lanes to allow their use only by vehicles carrying multiple occupants. During the previous two years, engineers had already introduced "ramp meters," which "limited entering vehicles to a fixed rate of flow." Then in the spring of 1976, for 21 weeks, officials marked the leftmost lane in each direction on the Santa Monica Freeway between downtown and western beach communities for carpools and buses. Indicating to some that this policy had

promise, it caused a 65 percent growth in ride sharing on the facility and bus ridership tripled. Even though the throughput of people during peak hours increased on the freeway, television and newspapers reported that "non-carpoolers lost far more time than carpoolers gained, and a heated public outcry developed which has delayed the implementation of other preferential treatment projects in Southern California."[56]

One regulatory approach to traffic control used far more in eastern cities than Los Angeles is the conversion of streets to one-way operation. In 1947, Fifth and Sixth Streets in downtown were converted into a one-way pair, the first in Los Angeles. When planning for the 1984 Olympics traffic officials proposed converting Olympic and Pico Boulevards into a one-way pair, a recommendation that has been made several times since. But, each time opposition from homeowners and business groups has defeated the proposals which have been shown by traffic engineers to offer only modest improvements in flow because of street configurations in Los Angeles.[57]

One-way street pairs tend to smooth traffic flow and reduce delays, working best where block sizes are small and are most beneficial where streets are narrow, as they are in downtown. In part because many Los Angeles streets were laid out to accommodate streetcars, their ample width easily accommodates two-way flows and diminishes the benefits of one-way operation. Because development in many areas followed widespread auto availability block sizes are large, increasing the circuity of travel if streets were to be converted into one-way pairs.

Ramp metering, parking restrictions, diamond lanes, and turn restrictions all aim to mitigate traffic congestion by regulating movement on existing facilities rather than adding new ones. Called Transportation Systems Management (TSM), these strategies helped avert disaster during the 1984 Olympic Games in Los Angeles. Looking back three years later, Genevieve Giuliano, then of the Institute of Transportation Studies at UC Irvine, heralded the Games as bringing about "the most comprehensive TSM program ever undertaken" but she warned that such effects were "unique" to this situation and "short-term." System management was complemented by Transportation Demand Management (TDM), which attempted to regulate traffic at its source rather than on the road. Her research described a variety of mostly voluntary accommodations by event schedulers, employers, and commuters as having had measurable impacts on reducing traffic congestion. Many companies switched to four-day workweeks, staggered start times for different workers, delayed construction projects until later in the summer, and relegated truck deliveries to evenings. For two summer weeks, Los Angeles traffic flowed smoothly, but congestion began returning to "normal" before the Olympics were over, as drivers noticed the worst predictions had proven to be exaggerated.[58] More recently, during the "Carmageddon" episodes of 2011 and 2012, after being told to stay home because of the weekend closure of the San Diego Freeway, many opportunistic drivers noticed the empty freeways and again filled them before the scheduled intervention ended.[59]

Three years after the completion of Giuliano's study, Los Angeles Mayor Tom Bradley announced an eight-point plan to make Los Angeles traffic flow forever as it had during the Olympics. Bradley's plan gave prominent roles to police as shepherds of faster and more efficient traffic flows, emulating earlier periods in Los Angeles history. During World War II, there had been traffic police stationed at congested downtown intersections in greater numbers than served on San Francisco's entire police force.

Southern California also had a long tradition of event policing where traffic officers helped guide motorists in and out of large parking lots. Pasadena's annual New Year's Day Tournament of Roses caused massive traffic jams during the postwar years. In 1947, the police chief solicited the assistance of the state, county, and City of Los Angeles which together sent 1,300 officers to assist. From his perch floating in a blimp, the chief sent radio commands to reroute cars to side streets before police and drivers at ground level could even see the jam of cars backing up several blocks ahead.[60]

Bradley offered the L.A. Police Department emergency powers to help free the flow of traffic permanently. The city penalized drivers whose selfish behavior blocked streets and substantially slowed traffic. Los Angeles asked San Fernando Valley's State assemblyman, Richard Katz, to sponsor a law authorizing California cities to "prohibit a driver from entering an intersection or marked crosswalk, notwithstanding any official traffic control signal to proceed, unless there is space on the other side for the vehicle driven without obstructing the through passage of vehicles from either side." To enforce this new norm, Katz considered granting citizens power to issue citations. Instead, Los Angeles Council member Mike Woo wrote an ordinance to fund the painting of signs saying "Do Not Block Intersection," creating a special LAPD task force, and providing for the collection of fines. The cost of a ticket for an illegal left turn or running a red light rose from $35 to $50. Fifty dollars was also the baseline fine for a first violation of the new anti-gridlock ordinance. Cited drivers paid $100 for a repeat offense and $200 for every citation that followed. The city announced a list of 84 problem intersections. During "an initial enforcement period," 10 to 15 motorcycle officers daily roamed those during peak hours issuing enough tickets for the fines to cover the cost of their labor. [61]

Bradley also promoted an ambitious plan to target truck traffic. In an early press release, the mayor identified truckers as villains in the story of urban congestion. He promised that "truck operators would be given clear incentives to stay off the roads when the commuters need them most - at rush hour." Drivers who made deliveries between early morning and midday or between midday and the evening were to pay "peak load pricing." Los Angeles floated plans for a "Truck Control Program" to cull 70 percent of vehicles at peak hour by selling a finite number of badges licensing a limited number of trucks to use freeways at those times. The city also planned to lobby the state legislature for legislation charging truckers "a fine that will be calculated based on the degree of disruption" if a driver caused "traffic-snarling accidents." In response, Caltrans hired the consulting firm of Cambridge Systematics to assess the legality of these proposals. Their report concluded the program would not be legal under the Surface Transportation Assistance Act of 1982. They advised the Mayor not to consider anything more than an "incident management strategy," which survives today as the "Freeway Service Patrol" continuing to provide rapid assistance to stalled vehicles and clearing away wrecks after crashes.[62]

Legislating Traffic by Regulating Land Development

> *"The traffic problem is merely that cars by the millions enslave us to new city systems requiring hours of driving to & from needs, on "congested" arteries, naturally– where once you'd-a walked."*[63]
> *Jack Kerouac*

Recognizing the connection between traffic and land use that was discussed earlier, the regulation of traffic has often been achieved by attaching requirements to real estate developments as a condition for the approval of proposed buildings. After community opposition led to cancellation of the proposed Beverly Hills freeway during the 1970s, slowing development of Century City, one of Hamilton's designated "centers" soon to be served by a new Purple Line heavy rail subway station, then City Council member, Zev Yarovslavsky, appointed a Citizens Advisory Committee to study the potential effects of more development there. Traffic congestion was their "prime consideration," and the group recognized that people living or working in Century City, plus those who visited, arrived mostly in singly occupied automobiles (at a rate of 1.1 persons per car as opposed to 1.36 in downtown). The committee recommended "phased development" to reduce traffic based on "a formula taking into account vacant office space in Century City as well as the traffic conditions on the major streets serving the area. Though this strategy formally linked land development to traffic and its proponents believe it helped prevent congestion by rationing future growth in demand, there is no evidence that it had much effect. The new policy did not reduce congestion nearby nor slow the growth of traffic due to expanding development on the west side.

Increasingly frustrated by growing congestion and recognizing that land development generated the traffic that caused it, in 1986 Yarovslavsky and fellow council members Marvin Braude and Joel Wachs went citywide with land use regulation to control traffic. They authored Proposition U, the *Initiative for Reasonable Limits on Commercial Building and Traffic Growth*. The measure, approved by L.A. voters in 1986, reduced the Floor Area Ratio (FAR) — the amount of development permitted for that property in relation to its total area — in half for a majority of the city's commercial- and manufacturing-zoned land. Proposition U was vigorously supported by "anti-growth" homeowners' associations and community groups who attributed worsening traffic congestion to high-density commercial and office construction along major boulevards. The "pro-growth" opposition to Proposition U included developers and labor leaders concerned that the initiative would decrease the value of commercial property and prevent new businesses from locating in L.A. Both sides believed that tightening land use regulations would benefit homeowner property values while harming commercial land values. After receiving "yes" votes from roughly 70 percent of Los Angeles voters, Braude and Yarovslavsky said they believed they had motivated developers to build "projects of appropriate human scale" with "a sense of a streetscape for people, not automobiles.[64]" Opponents responded that the measure preserved low-rise auto-oriented strip malls. A year later in 1988, consultant Christopher B. Leinberger alleged Prop U achieved the opposite effect; he claimed that by prohibiting

"urban villages," i.e. Hamilton's Centers, the city had discouraged "closer proximity" between "jobs and housing."

Despite these claims, recent research at UCLA showed that following its enactment, commercial land prices did not experience any measurable increase due to scarcity of supply and that Proposition U appeared to have no effect on residential property values, which continued to climb due to market factors that cannot be attributed to the measure.[65] In an unpublished 1994 study of development patterns following Proposition U, urban planners Chien-Hwa Chen and Charles Hotchkiss reported that commercial development—and traffic congestion–had continued citywide more or less as they would have without Proposition U. One of the proposition's authors, Zev Yaroslavsky, asserts that while citywide the changes in development patterns and traffic generation have been small, the measure discouraged the building of enormous regional shopping centers in predominantly residential areas.[66]

Debates continue because of the measure's ambiguous effects on the city, and it is telling that not a single study has related the proposition's effects to either worsening or relieving traffic congestion, ostensibly the motivation for presenting it to voters. Traffic may have risen or fallen adjacent to new development and risen or fallen regionally as a result of many different developments across the city. Traffic counts on any street or highway cannot be easily or conclusively attributed to land use changes affected by the proposition and traffic changes result from population growth and economic conditions along with land use regulations. Another dramatic action aimed at easing traffic congestion, like many that came earlier, gave rise at best to a mixed and ambiguous result.

A Common Engineering Measure of Congestion

Streets have a capacity for traffic that depends on their width, number of lanes, traffic signalization, and parking at the curb, and a roadway operating near or at capacity is congested. To rate the performance of streets and roads, traffic engineers use a measure called level of service (LOS). Most measures of LOS calculate the ratio of volume - the number of cars traveling on a roadway - to capacity - the number of cars that could theoretically be carried on that roadway. LOS measures are also commonly called volume-to-capacity ratios (V/C ratios). LOS is presented as letter grades, usually from A to F, to show how "congested" a roadway is, with LOS A being completely uncongested and LOS F indicating that the traffic on a road segment exceeds its capacity.[67]

The optimal, or best LOS, unlike classroom grades, is not necessarily A. Caltrans, for instance, states that for an intersection, at a busy hour of the day and in a busy location, an appropriate LOS target is "on the cusp between C and D."[68] A major urban road that has LOS A during peak traffic hours is underutilized and serves many fewer vehicles than it could. LOS targets between C and D allow a roadway or intersection to serve closer to its theoretical maximum capacity, while being able to accept some more vehicles without decreasing flow.

LOS has long been used as a measure of regional development capacity. A proposed development, like a shopping center or a residential complex, increases demand on a roadway and lowers LOS in a regional network. If this deterioration is greater than a threshold specified in local ordinances or regulations, or brings an area below a certain LOS, a city usually requires that the loss of LOS be mitigated by the developer as a condition for approval of the project. In the logic of a volume-to-capacity ratio, if the volume is predicted to go up, in order to maintain or prevent lower quality LOS, then so must capacity. (Examples of capacity increases may include adding a lane to an intersection or road segment or a turn pocket.) While recent legislation, California Senate Bill 743 eliminates replaces level of service as a metric for

environmental analysis by vehicle miles of travel, many local governments continue to use LOS to represent traffic levels.

For decades, in order to comply with the California Environmental Quality Act (CEQA), developers were required to mitigate forecast traffic impacts of proposed projects. If projected traffic from a new commercial office building or residential tower caused deterioration in peak hour traffic level of service at intersections located even miles away from the proposed project, the mitigation requirement led to requirements that developers carry out or pay for street widening, the addition of turn lanes, and upgraded traffic signals. Road improvements as conditions for the issuance of building permits logically link traffic regulation with the belief that traffic is best addressed by enhancing capacity. Reflecting the more recent acceptance of the view that the enhancement of capacity induces more trips, the California legislature enacted Senate Bill 743, a major change in approach to the mitigation of traffic from new buildings. Starting July 1, 2020, developers must comply with CEQA by taking action to reduce vehicle miles of travel from new buildings rather than accommodating the traffic they generate. Now, developers must comply by providing, for example, bicycle racks and shower facilities, charging employees and residents for parking and providing fewer spaces, providing employees and residents with transit passes, and in the case of some larger buildings buying buses for the local transit operator or building pedestrian tunnels to nearby rail stations.[69] It is difficult to assess at this early date whether the change in policy will result in measurable reductions in travel or whether they will be more effective at reducing congestion than the capacity expansions that were previously required. In all likelihood, because traffic volumes simultaneously change locally and regionally as a result of many factors, it will be as difficult to measure the consequences this change as it was to attribute changes in traffic levels to Proposition U.

Recently, California State Senator Scott Weiner introduced three bills that would have overridden local zoning and density restrictions to boost housing production near transit hubs and in job-rich areas. Had he been successful, this legislation would have changed California local zoning ordinances, including those in Los Angeles, to allow substantially higher residential densities in communities served by high quality public transit service. Though higher density development would be allowed and not required near transit stations, widespread opposition to his initiatives was particularly strong among homeowners' associations, Los Angeles City Council members, advocates for increased provision of low income housing, and state legislators representing established lower density communities, many of which are well served by public transit. Senator Weiner's failed initiatives have, however, reopened familiar acrimonious debates about the future of the city. If the transit investment program costing hundreds of billions of dollars that already is well underway is to be successful, supporters argue that urban form should change dramatically to promote travel by transit. Opponents, not necessarily opposed to transit investments, argue that increased density will increase congestion and destroy the integrity of neighborhoods, conforming to the vision of Los Angeles promoted by the real estate developers more than a century ago. The history reviewed in this paper would suggest that claims about traffic congestion made by proponents and opponents of Weiner's proposals will be difficult to forecast and outcomes difficult to measure. The arguments about traffic congestion are

politically salient but may again be very loud precisely because they cannot easily be resolved by data and analysis.

The history of regulating congestion directly and indirectly by regulating land uses that generate traffic demonstrates inconsistency and indecision similar to that revealed in earlier sections. Some regulations attempted to accommodate traffic flows, reinforcing or complementing strategies that added capacity in the face of worsening congestion. Other regulatory strategies tried to reduce traffic, often by adopting restrictive measures. Though they appear to compete with or contradict one another, both approaches have been pursued, often simultaneously, for over a hundred years.

Figure 9. Traffic engineer S.S. Taylor posing with an electronic map of Sunset Boulevard, 1964[70]

Communicating Better Information about Driving

> *"Take an Alternate Route; Take an Alternate Route*
> *It's a Lovely Day for an Alternate Route"*
> *Folks Songs for Freeway Drivers or Sigalert Singalong*[71]

Prior to the slowdown in freeway building in the 1970s, officials had introduced traffic reduction measures that included rapid communications between drivers and traffic engineers. As traffic conditions changed, quicker and better informed decisions became possible as radio programming, traffic signal synchronization, and mapping software advanced.

Sigalert, a program warning drivers of non-recurring traffic disruptions, reflected this communications revolution. Vehicles were outfitted with radios starting in the 1930s, but they required constant maintenance due to their fragile vacuum tubes. Car radios became more reliable with the introduction of transistors after the Second World War. New cars increasingly came with dashboard radios in the 1950s. Sigalert arrived in the fall of 1955. The Southern California Auto Club's magazine, *Westways*, recounted the story. Short radio broadcasts, interrupting regular programming on commercial stations, advised motorists to avoid the effects of a crash or a flooded road. This public service began as the brainchild of a KMPC radio executive, Loyd Sigmon. Named for him, Sigalerts also fulfilled a need for coordinating civil defense in the event of a Cold War era aerial attack. Within two years, the LAPD had assigned helicopters to observe

rush hour traffic. From headquarters, police could interrupt broadcasts at 16 radio stations with the push of a button. One officer predicted "an inexpensive, small battery-powered Sigalert receiver for every home in the country - and for every automobile."[72]

Westways also reported another technology: the "traffic computer" from Canoga Park's Thompson Ramo Wooldridge, Inc., founded by graduates of Caltech working at Hughes Aircraft. Los Angeles purchased one of the company's TRW-300 computers after Mayor Sam Yorty ordered "automatic data processing" to cut costs at several agencies in 1962. The new machine helped synchronize traffic signals along Sunset Boulevard, an important route roughly paralleling parts of the Hollywood Freeway. The Office of Naval Research reviewed this networked machinery because it was "the nation's first use of a digital computer by a city for traffic signal control." Traffic signals changed according to several pre-programmed patterns optimized for diverse conditions, including rainstorms, popular events like games at the then new Dodger Stadium, and rush hours. With a cutting-edge map outfitted with lights that flared differently to signify when and where traffic was congested, engineers held the power to adjust the pattern of lights speeding and slowing traffic on Sunset from one setting to another as needed. Better than local traffic police, engineers had a top-down view of "the overall traffic pattern." Anticipating finding more uses for traffic computers, like on the "access roads to the freeways," the City ordered one with extra memory, which engineers eventually improved allowing for the synchronization of signals in an expanded area.[73]

Meanwhile, and as discussed earlier, concerns about worsening Los Angeles traffic conditions reached a fever pitch leading up to the 1984 Olympic Games, which occasioned the application of more information technology. City Hall's traffic computer played a starring role in a *Los Angeles Times* report of a worst case scenario for the Games' busiest day, August 3rd, 1984. "[H]undreds of tiny lights embedded in a giant wall map of Southern California gradually, almost ominously, shift from green to amber, then to solid red, and to the final condition - blinking red." This would have been gridlock, the "heart attack" observers feared. Even more important were innovations like cameras affixed to downtown skyscrapers that took high resolution pictures of freeways miles away and other cameras strategically placed on the Santa Monica Freeway. Designated to immediately tell traffic officials the source of congestion…" the computer automatically recalibrates freeway on-ramp meters so the congestion does not increase." Called Automated Traffic Surveillance and Control (ATSAC), this system expanded traffic flow synchronization to 4400 intersections and onramps in the city. Many of these intersections were upgraded at the expense of real estate developers to fulfill their traffic mitigation obligations described earlier. However, even metering could not fix traffic when backed up cars disrupted surface street traffic for miles.[74]

In the years to come, based on successes in Europe and Japan, Mayor Bradley included in his plan to reduce traffic the expansion of this system from 212 intersections in the downtown area to a much larger number that included arterials on the Westside paralleling the Santa Monica Freeway and in the San Fernando Valley paralleling the 101 Freeway. This eighth point in Bradley's 1987 traffic plan promised to accelerate the plan to finish ATSAC's expansion from 30 to ten years. Estimates showed that drivers experienced 35 percent fewer stops at ATSAC intersections, and that the program would deliver a 13 percent reduction in travel time along these corridors and a 15 percent increase in average speed. In 1990, city transportation engineer John Fisher noted this

project would increase the effective capacity of Ventura Boulevard by 7 percent. ATSAC's goal was to speed traffic flows, but Fisher's calculations indicated the system induced as much additional demand as street widening projects.[75]

Also in 1987, a public-private partnership unveiled Pathfinder, the most significant effort since Sigalert to improve traffic flow by making better information directly available to drivers. The sponsors included state and federal agencies plus General Motors, which donated 25 vehicles outfitted with a navigation system called ETAK Travelpilot. While in motion, these cars kept in direct communication with a central computer via two-way radio. Broadcasting speed and direction to a traffic center under City Hall that had formerly been a nuclear fallout shelter, the cars also received data about traffic conditions and displayed them on a digital map that drivers could check on their dashboards. Then-Undersecretary (and now Secretary) of Transportation Elaine Chao demonstrated the project. While driving, she safely checked the computer for updates and adjusted the map to show either the "zoomed-out" Los Angeles region or just the surrounding few blocks at a finer scale. The device discouraged distraction by disabling functions like typing into the machine unless "the car is stationary" and by reading information to drivers out loud in a synthetic voice.[76]

With Pathfinder showing such potential as a telematics trial, Caltrans heightened its ambitions to transform the Santa Monica Freeway and its surrounding streets into a "Smart Corridor" in 1991. Electronic "changeable message signs" gave drivers alerts about upcoming hazards and updated them about how long it would take to reach major destinations. The *Los Angeles Times* reported that the project's engineers predicted 15 percent in additional freeway "carrying capacity." As time passed, plans to collect and disseminate traffic information became even more ambitious. Cable television companies set aside Channel 35 for a traffic map of the region's 750 freeways miles, updated every thirty seconds, with green, amber, and red colors signifying whether various stretches were open or congested.[77]

The information technology that allowed some workers to telework allowed others to meld work hours into their commutes. Sociologist Manuel Castells has called "[m]oving physically while keeping the networking connection to everything we do…a new realm of the human adventure." Car phones marked the demise of the car as a private mode of transportation in which workers had time to take a break from other concerns. Increasingly "smart" handheld media devices meant workers had less cause to miss a call or cite an unpredictable drive across the city as an excuse for late arrival. Employers had new expectations that workers might access every source of information technology to aid them in systematizing the commute. These media gradually supplanted street atlases like the *Thomas Guide* and a 1990s guide entitled *Freeway Alternates* by "Dr. Roadmap" (a house-calling podiatrist named David Rizzo). His book mapped surface streets, which required knowing Los Angeles "B.F. (before the freeways)" and the routes freeway travel had "obscured." He collected information by driving 30,000 miles a year. Today Waze and other traffic apps today give instant access to higher quality data to any driver with a smartphone.[78]

Figure 10. U.S. transit official Elaine L. Chao demonstrates the use of the system that will be tested in the Southland.[79]

Ridesharing and Telework

> *"Cultural revolutions take longer than technological ones."*
> *Jack Nilles, Networkworld, 15 May 2007*[80]

Information technology increasingly is enabling telecommuting that, even before the current pandemic, encouraged some drivers to work from home and not commute at all on some days. Futurist Alvin Toffler popularized the expectation that physical commuting might end in years to come when he published *The Third Wave* (1980). He described "electronic cottage" industries in suburbs where companies could outsource labor. This reflected a decade of experimentation in Los Angeles, where the demands of environmentalists for better air quality and the energy crisis of 1973-1974 led to ridesharing and telework programs meant to reduce the number of cars, the amount of smog, and the country's dependence on imported oil. During the COVID-19 pandemic, Toffler's dream appears to have belatedly - and perhaps temporarily - taken hold.[81]We live in an Information Age, an era of growth in the application of electronic devices, the reach of networks linking them, and the scale of personal and institutional information-processing that swiftly translates data sets into knowledge. The history of traffic reduction indicates that even as information technology improved efficiency, traffic congestion would persist as an enduring urban problem.[82]

Radio station KFWB initiated information-based traffic reduction initiative: "The Commuter Computer Car Pooling Plan." Carpooling had been popular during the Second World War when defense workers, faces with fuel and rubber rationing, often drove together from the same residential tracts to the same plants and shipyards. At that time, employers could help coordinate these trips because so many workers started and ended their shifts at the same times and left their homes for the same destination. By the 1973-1974 energy crisis, calls for drivers to carpool resumed even though trip patterns had become far more complex in space and time. South Coast Air Quality Management District Board member Esther Lewin touted Treasury Department estimates for tremendous fuel savings if only her countrymen shared their commutes and turned their home thermostats down a couple degrees in the winter and up a few in the summer. KFWB's management volunteered to support carpooling by encouraging commuters to submit applications containing their work and home addresses and to accept a placement matching them with other commuters. Five years later, Commuter Computer had raised millions of dollars in federal grants and sponsorship by the L.A.-based Atlantic Richfield Company, and the Southern California Association of Governments. Out of an estimated 3.7 million Los Angeles area commuters, 250,000 had contacted the program, information for 120,000 was available in the database, but only 15,000 had been successfully matched, and not all matched participants participated in carpools.[83] The dispersion of origins and destinations and the wide variety of work hours discouraged successful matches.

Telework or telecommuting softened the blow inflicted on the region by the energy crisis. Coining these new terms was consultant Jack Nilles, a futurist and newcomer to the USC faculty of interdisciplinary studies. Research for 1973 book, *The Telecommunications-Transportation Tradeoff,* had begun when the Clean Air Act passed three years earlier. He advised employers to think beyond the central office model. In addition to a corporate headquarters, firms could scatter "local work centers" throughout the region. Nilles envisioned this structure leading to "part-time job mobility." Workers might commute to headquarters for the whole week, every other week, or just come in on a few select days per week. The best of both worlds would be available to employees who neither commuted daily nor worked exclusively from home. Telework grew slowly but steadily. Research in the 1980s illustrated that telework had hardly changed Los Angeles's business landscape or changed traffic congestion. Looking back, Nilles estimated only 3 percent of workers full-time telecommuted, but he expected this figure would double by the end of the decade. No such change followed, but growing numbers worked in part from home instead of full-time at satellite offices.[84] Working at Home (WAH), has been the fastest-growing "mode" of travel to work in America since 1970, growing at twice the rate of growth in the size of the workforce. By 2017, more than 5% of "commuters" worked at home, surpassing the percentage of people across the country that used mass transit. Working at home now has the third-highest share of work "travel," trailing only car-pooling at 9%, and driving alone at more than 76%.[85] COVID-19 has dramatically increased the share of those who work from home, but will that change last? Post-pandemic patterns of working and commuting are difficult to predict. However, Nilles' vision has come to pass, at least for now.

Congestion Pricing: Has Its Time Come?

> *"The age of congestion pricing may finally be upon us."*
> *Aarian Marshall, WIRED, 28 February 2019*[86]

Google Maps, Waze, and Lyft today calculate the least-congested paths between a traveler's origin and destination. Ride-hail companies like Uber sell customers trips at prices that vary from one minute to the next in response to changing demand for rides and levels of congestion. While the cost of driving has played a small role in past efforts to reduce congestion, information and communications innovations have recently enabled responsive pricing, which economists have discussed since 1920 when Arthur Pigou proposed tolling as a means of diverting some traffic from a theoretical high-quality road onto a lower-quality but underutilized alternative route. Pigou proposed that the charges be levied by government, but Frank Knight countered that entrepreneurial landlords should purchase the superior route and charge its users "rent" for choosing the more desirable driving experience. Despite this difference, the two shared a vision a century ago that a system of road pricing could foster a flow of vehicles most beneficial to the greatest number. While some drivers paid for the luxury of smooth, free-flowing traffic on a toll road, others could opt to enjoy un-congested passage along a road less maintained, longer, or less traveled for any reason.[87]

Decades later, Nobel prize winning Columbia University economist William Vickrey stressed the negative "externalities" associated with urban and suburban transportation and the "gross underpricing of some modes relative to others." Unwilling to charge drivers fees to use roads, Vickrey believed that U.S. cities would become so filled with automobiles that buses regularly would fall behind schedule. Pricing car trips might encourage the possibility "that the level of congestion is kept down to the point at which buses will provide a satisfactory level of service." City planners also set aside so much space in downtowns for cars that businesses tended to become "uneconomically dispersed" into industrial suburbs, an effect Vickrey believed pricing might deter for "greater preference should be given to space economizing modes of transport." He neither prescribed a use for the revenues nor addressed the quality of life for drivers. Instead, Vickrey highlighted congestion's role in the failures of the city to be accessible to bus riders and business people. His writings included practical instructions about implementing pricing through the installation of an "electronic identifier" in every car and the "display of roadside signals…to indicate the current level of charge enabling drivers to shift to less costly routes."[88]

Wayne State University economist Wilbur Thompson further popularized placing prices on public goods. In 1965, he published the first college-level textbook on urban economics, which called for a new approach to urban transportation. Thompson's approach to the problem of traffic prescribed a significant role for the government to improve car travel without suppressing it. To Thompson, the central place of the automobile in U.S. society could be enhanced if an "official economist" in every city were given the chance to create a future for the car in which driving neither threatened the quality of life nor widened gaps, both social and spatial, between rich and poor. In the

August 1968 issue of *Psychology Today,* Thompson published an article, "The City as a Distorted Price System," in which he zeroed in on the ways drivers in moving vehicles enjoyed a right to use the whole street for free.[89]

Thompson wanted city officials to use prices to help drivers make less selfish decisions. They otherwise had nothing to dissuade them from making trips when roads were most crowded that they could comfortably complete before or after peak hour congestion. He did not recommend high prices. Rather, he supposed that the price "could be raised only to the point at which some combination of moderately rapid movement and high physical output were jointly optimized…It is, moreover, quite possible, even probable, that the newly converted, rapid-flow, toll-route would handle as many vehicles as it did previously as a congested street and not therefore spin off any extra load on the free routes." Thompson also foresaw surface streets being relatively safe from displaced drivers leaving expensive freeways and arterials because pricing would persuade enough of them to change the hour of their trip that this effect alone would lighten the flow of traffic. A price mechanism could flatten spikes in usage by encouraging drivers to change their habits. Besides starting trips at different times, drivers facing a price had better reasons than ever to carpool, use transit, telecommute, or choose places to work and shop that were close to their residences.[90]

About the time that Thompson and Vickrey were writing in the United States, a commission of respected engineers and economists was created in the early 1960s by British Prime Minister Alec Douglas-Home to address growing postwar traffic congestion in London. Well ahead of its time, the study known widely by the name of its chairman as the Smeed Report, recommended congestion tolls like those eventually adopted there in 2003. The proposal was widely dismissed as impractical at the time and the Prime Minister stated that he deeply regretted having created the commission. But the Smeed Report brilliantly and succinctly enumerated nine criteria deemed essential to the success of a road pricing system.[91] They seem as relevant to Los Angeles today as they were to London almost 60 years ago:

1. Charges should be closely related to the amount of use made of the roads.
2. It should be possible to vary prices for different roads (or areas), at different times of the day, week, or year, and for different classes of vehicle.
3. Prices should be stable and readily ascertainable by road users before they embark upon a journey.
4. Payment in advance and by credit should be possible.
5. The costs for individual road users should be accepted as fair.
6. The system should be simple for road users to understand.
7. The equipment for charging should possess a high degree of reliability.
8. The system should be reasonably free from the possibility of fraud and evasion, both deliberate and unintentional.
9. The system should be capable of being applied, if necessary, to the whole country.[92]

Social consciousness informed scholarly interest in congestion pricing and inspired progressive officials in Berkeley to volunteer their city for a pilot study in 1976. Thompson had wondered if a "truly wide range of choice in urban transportation would allow the rich to pay for fast movement with money, the middle-income class to pay for

the privacy and convenience of the automobile with time, and the poor to economize by giving up (paying with) privacy."[93] When the City of Berkeley announced it would adopt congestion pricing, former California Governor Ronald Reagan said this plan was an attempt "to charge its citizens a daily tax to drive on the city's streets!" Hosting a nightly radio show during commuting hours that reached as many as 20 million listeners, most of them in cars, Reagan knew his audience. They were that middle-income majority willing to pay for mass motorization with their time rather than money. The soon-to-be president accused government bureaucrats involved with these "zany ideas" of being "mass transit zealots" hoping the higher price to drive into the city would get drivers to park at the edge and ride in by bus. "I have news for them," he said, "People don't behave that way. Their travel plans are as individual as they are, and they won't fit into neatly compartmentalized schemes."[94]

More to Reagan's liking were plans for a variation on the theme of congestion pricing from the Reason Foundation toward the end of the 1980s. Libertarian transportation writer Robert Poole had coined the term "privatization" - governments selling, leasing, or franchising public goods - in 1980. In the *L.A. Times*, Poole advised readers in 1989 to support efforts by capitalists to construct for-profit toll roads as an alternative to traffic-clogged freeways. With variable pricing, such that managers could "raise the tolls enough during rush hours to divert non-essential traffic to off-peak hours," this plan closely followed Frank Knight's original proposal. Managed as a business enterprise, "express lanes" would keep costs to a minimum while providing customers a free-flowing driving experience.[95] This case also was made by the California Private Transportation Corporation for the first express lanes it opened in 1995 – four priced lanes added to the median of a free but heavily congested freeway running through ten miles of Santa Ana Canyon in Orange County. The *Times* wrote that transportation engineers would learn from the "side-by-side test of a variable toll with a free facility."[96]

Leftist California Senator Tom Hayden, whose politics contrasted dramatically with the views of Ronald Reagan, loudly attacked the new 91 Express Lanes, as they were called, pinning to them the label of "Lexus Lanes." He believed that low income people would remain stuck in traffic in the free lanes, while rich drivers zoomed past them at high speeds after paying the toll. Studies soon showed him to be mistaken, adding empirical evidence that pricing could, as Thompson and Vickrey believed, benefit all travelers. A UCLA study showed that had the four new lanes been free of tolls and financed instead by regressive transportation sales taxes, the burden of paying for them would have fallen more heavily on low income people. The tolls that financed the new lanes were being paid to a far greater extent by upper income rather than lower income travelers.[97] Surveys of users showed that lower income travelers used the toll lanes less often than rich drivers, but welcomed the opportunity to use them when they had an emergency or high priority appointment for which they wanted to be sure to be on time. Travel times had improved in the free lanes as some travelers diverted to the tolled ones, resulting in expressions of support for tolling from drivers across the income spectrum, even those who did not drive in the lanes. A survey of public opinion in the surrounding community showed that a majority of the population was hostile toward toll lanes before they opened, but one year after their opening a follow-up survey

in the same community showed a remarkable turnaround, with a majority agreeing that express lanes were a "good idea." [98]

Figure 11. Photograph of I-110 south of downtown showing the express lanes and general flow lanes

In response to what many considered a successful demonstration of express lanes, Los Angeles Metro followed by converting what were previously high-occupancy vehicle (bus and carpool) lanes into express lanes that charge vehicles carrying one or two people on the I-10 running east from downtown and I-110 running south from downtown, which have been operating since 2012 and 2013, respectively. Also in response to the growing number of successful variable toll lanes, the regional planning agency SCAG included a proposed regional network of express lanes in the current Regional Transportation Plan[99] while L.A. Metro plans to expand the express lanes over 25 years into a countywide network.[100]

Adding to our collective understanding of the importance of pricing in transportation is the work of Professor Donald Shoup of UCLA, whose 2005 book, *The High Cost of Free Parking*, and whose subsequent studies make clear that free employer provided parking at work places, free developer-provided parking in residential developments, and free parking at commercial establishments all induce driving, contribute to congestion, and discriminate against lower paid and minority workers who have lower access to cars, on average. He also has demonstrated that no- or low-cost curb parking induces "cruising" for scarce parking spaces that in some congested areas can account for a substantial proportion of the traffic on a street. Shoup has called for the government to tax the cost of employer-provided parking as part of a worker's income. He proposed that any worker whose employer that pays a 3rd party to provide them employees with free parking should offer their employees the option to take the cash equivalent instead of the parking, a feature now in California law but rarely enforced. He argues furthermore that curb parking should be variably priced to insure, by raising and lowering the price over the day, that at least a few parking spaces on any block are empty at all times to eliminate circling, or cruising, in search of a street parking space in an effort to avoid paying higher prices in off-street parking garages.

Shoup's meticulous work shows that society benefits from charging all drivers demand-based variable rates to park, as opposed to collecting the cost of "free" parking indirectly from "consumers, investors, workers, residents, and taxpayers." Under the current system, he points out, "…even people who don't own a car have to pay for 'free' parking," that encourages driving and leads to congestion. [101] Ubiquitous free parking is inefficient, worsening congestion and imposing heavier costs on the poor than the rich. Despite the evidence, the withdrawal of free parking is politically challenging because it

means pricing a resource that most voters take for granted. The parallels to road pricing are important. We all pay for our own inefficient roadway travel in ways other than direct tolling and almost universally fail to recognize that we do.

Shoup co-authored a sophisticated analysis of the politics of congestion pricing with David King and Michael Manville. "The Political Calculus of Congestion Planning" prescribed a coalition-building strategy to win voter approval for pricing Los Angeles area freeways. A strategy to achieve this end would be to offer the revenues from the charges collected to city governments. Unlike business owners and investors, public officials could use this money to fund programs "to compensate cities for the various environmental and public health costs the freeways bring," and perhaps more importantly, had historically brought to minority communities more than others. Stressing that not all cities had been equally "penetrated" by freeways, the authors argued this money from congestion pricing should be distributed according to an assessment of the level of local community impact. With reference to data from the 2000 U.S. census, the authors noted 66 Los Angeles area cities with freeways had an average income of $20,100 while the 22 without, where a minority of Los Angeles County voters lived, earned $35,100 per capita. The dynamically priced express lanes on I-110 and I-10 discussed above, share revenues with nearby commuter bus services.[102]

The most vocal debates about the possibility of testing congestion pricing in Los Angeles have been about fairness. Equity challenges to the idea of charging for something that was previously free are common, and likely even more so following the spring 2020 demonstrations against policy brutality and anti-Black racism. Congestion pricing can be quickly dismissed as a tool to speed rich white people to their

Pricing Types and International Comparisons

There are three primary types of congestion charges, and one proposed by L.A. Metro:

Facility: Tolls that vary with time or day or location based on traffic flows are collected on roads, bridges, tunnels, or on one part of the targeted facilities such as express lanes or toll bridges.

Zone: Vehicles entering a bounded area and traveling within it pay a toll. The bounded area is often established based on geographical features and boundaries within a city.

Cordon: Vehicles pay a fee for crossing a boundary. Traveling within the bounded or cordoned area does not incur a fee.

Corridor: Proposed by L.A. Metro, corridor pricing would price all roads in a corridor (such as Sepulveda Blvd and the adjacent I-405) with high congestion levels and a viable transit alternative.

Zone and cordon pricing have been used internationally. Singapore, the first major metropolitan area to implement a system of congestion pricing called the Area Licensing Scheme (ALS) (1975), uses cordon-based pricing as part of its Electronic Road Pricing system (the successor to ALS). After ALS was implemented, congestion within the area bounded by the cordon "was virtually eliminated."[103] In 2003 and 2007, respectively, London and Stockholm instituted cordon-based congestion charges for car travel into their downtown cores and reduced congestion there by 30%.

destinations while charging working class indigenous people and people of color to drive on roads they have no choice but to use. The potential political success of pricing proposals will depend on argument and evidence that often is in short supply in congestion pricing equity debates. Thompson, Downs, and Vickrey each argued this political point decades ago. We earlier cited a UCLA study establishing that the 91 Express Lanes were paid for to greater extent by richer than poorer travelers, and that low-income users expressed satisfaction with the option provided by the toll lanes. UCLA Professor Michael Manville is one of several authors to have shown that congestion pricing in fact tends to advance the wellbeing of lower-income and non-white communities. The perception that congestion pricing would harm the poor and non-white residents is intuitive, but not empirically supported, and works to promote the interests of upper income drivers who would have to pay dramatically more under congestion pricing than would the poor.

The starting point for this counter-intuitive argument is documented evidence that the current transportation system is highly inequitable. Travelers having lower incomes, including many Black, Latinx, and Indigenous people, depend more on slower public transit, are more likely to live in neighborhoods polluted by vehicle emissions and noise, and pay more in taxes relative to their income to support transportation in Los Angeles than do higher income people.

Los Angeles County voters have approved four separate half-cent sales tax increases since 1980. Sales tax revenue provides most of Metro's budget, complementing fares and state and federal funds. But the sales taxes that pay for transit are in general more regressive than congestion tolls – lower-income people pay more of their income in sales taxes than do higher-income people. The bottom 20% of California households by income pay almost 7% of their income in sales taxes, while those in the top 1% pay less than 1%. Even if bus fares were free, as recently proposed by some in the interest of social equity, this higher taxation of the poor would remain, while the programs financed by the taxes disproportionately benefit upper income and white travelers. Placing the arguments of Thompson and Downs into the current context, Manville argues that congestion pricing tends to correct a gross transportation inequity.[104]

Conclusion

> *"A Twilight Zone version of Hell is a man trapped for eternity behind the wheel of his car in a traffic jam as punishment for his driving misdeeds. For many Californians, that Hell feels like reality as they face the daily frustrations of the State's inadequate freeways and highways."*
> *Nathan Shapell, 1992, Chairman of California's Little Hoover Commission*[105]

Throughout the history of Los Angeles, elected leaders and lay people have worried about future impacts of traffic congestion on businesses and the health of residents. Congestion has been addressed in every era and in numerous ways, but always has returned. Congestion pricing has been placed on the public agenda at this time because it is being studied by L.A. Metro and SCAG. It is based on proven theory of human economic behavior promoted for a century, proven in application to sectors of the economy other than transportation, and enabled by recent advances in telecommunications technology. It has a proven track record in such diverse places as Singapore, London, Stockholm, and on three express lanes in Southern California.

The history of traffic congestion in Los Angeles and the current political environment both make it clear that the debates to come about fixing L.A.'s notorious traffic will be acrimonious. This paper reflects the expectation that the debate will benefit from consideration of new strategies and will be more reasoned if informed by lessons learned from history. The current debate imagines the city of today, with current congestion levels, as a starting point that is difficult to change, but it is better understood as the result of many historical events and policies and ultimately amenable to change. There is skepticism as to whether or not congestion pricing would have any effect but little appreciation for how past congestion policies had failed in their aims nor how effective pricing has been in many other places.

Many stakeholders might benefit from reduced congestion more than they would suffer from driving being priced, though most do not yet recognize that possibility. With reduced automobile traffic along bus routes, transit riders could enjoy more reliable service and quicker trips. Drivers who are paid per trip, per service call, or per delivery, rather than hourly, could benefit economically. Managers who oversee just-in-time delivery operations might not have to account for as many variables. Commuters could have more control over their time, and may be motivated to ride on transit or work from home occasionally. The city could require less space for parked and standing cars and more room for housing, services, businesses, and activities that produce more tax revenue. Neighborhoods, workplaces and schools would benefit from breathing less polluted air. Effective congestion pricing could unlock such benefits, but only after the concept is carefully studied and is accepted by a majority of representatives of many constituencies. Nobody wants to pay for something that is currently free, but we must systematically compare a system that levies congestion prices against free streets and regressive gasoline and sales taxes, parking fees, and valuable lost time. We do not

predict that the current discussions will lead to the adoption of congestion pricing, but hope this paper contributes to the debate by demonstrating how diverse past efforts addressed congestion and how limited their successes have been.

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