Title
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Publication Date
2021-12-01

DOI
10.7922/G2GX48WF

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WHITE PAPER

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September 2021

DOI: 10.7922/G2GX48WF

Berkeley Institute of Transportation Studies

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This research was conducted with funding, in part, from the State of California Strategic Growth Council. The opinions expressed herein are those of the authors and not necessarily those of the Strategic Growth Council.

WHITE PAPERS IN THE SERIES INCLUDE:

Evaluation of California State and Regional Transportation Plans and Their Prospects for Attaining State Goals: Summary and Synthesis

Review of Statewide Transportation Plans for California

MPO Planning and Implementation of State Policy Goals

Examination of Key Transportation Funding Programs in California and Their Context

Flexibility in California Transportation Funding Programs and Implications for More Climate-Aligned Spending

Forward

Assembly Bill (AB) 285 (Friedman, 2019) requires the California Strategic Growth Council (SGC) to submit a report to the Legislature by January 31, 2022, that includes the following:

- An overview of the California Transportation Plan (CTP) 2050
- An overview of all regional Sustainable Communities Strategies and any alternative planning strategies, as needed
- An assessment of how the implementation of the CTP and regional plans "will influence the configuration of the statewide integrated multimodal transportation system"
- A "review of the potential impacts and opportunities for coordination" of key state funding programs" to be conducted in consultation with the administering agencies
- Recommendations for improving these programs and other relevant transportation funding programs to better align the programs to meet long-term common goals, including the goals outlined in the CTP

In spring 2021, the SGC contracted with the University of California (UC) to provide materials supporting their report to the Legislature. Researchers at the UC Berkeley, UC Davis, and UCLA Institutes of Transportation Studies and the UC School of Berkeley Law joined forces to prepare a series of white papers to provide the evidentiary basis for the project. Elizabeth Deakin, the UC Berkeley principal investigator, coordinated the work.

Background

California has adopted ambitious goals for its transportation systems. The state has pledged to reduce greenhouse gas (GHG) emissions by 40 percent compared to 1990 levels and by 80 percent by 2050, and has also committed to achieve carbon neutrality by 2045. With transportation a major emitter, substantial changes in transportation vehicles, fuels, operations, and user choices must be achieved to meet these goals.

As pressing as climate change goals must be, other goals remain important. California has pledged to maintain its transportation infrastructure in a state of good repair, provide for safe operations, support economic development, meet air quality standards, protect the state's natural environment, coordinate urban transportation with housing policies, and do so in a way that is equitable for all. This ambitious set of goals places considerable responsibility on transportation planners and decision-makers.

A series of state initiatives has moved the state toward zero-emissions vehicles, cleaner fuels, and planning for transportation and land use measures that reduce vehicle miles traveled (VMT). Nevertheless, a 2018 assessment by the California Air Resources Board (CARB) found that the State of California is at risk of missing its 2030 GHG emissions reduction target for transportation-related emissions, in part due to increases in VMT. Since then, CARB has taken steps to tighten its requirements, the California Department of Transportation (Caltrans) has updated its plans and planning guidance, and metropolitan planning agencies and their partners (transit agencies, county transportation commissions, cities) have updated their plans and programs, which include both transportation and land use elements.

California's transportation plans for the most part have been developed in a context of anticipated growth in population and the economy. In a business-as-usual context, such growth is associated with increases in VMT. Nationwide, for example, the Federal Highway Administration has projected that VMT will continue to increase as the result of population increases, rising disposable income, increased GDP, growth in the goods component of GDP, and relatively steady fuel prices. For California to buck these trends would require a large-scale, concerted effort.

However, in the past two years, the COVID-19 pandemic has disrupted daily life and led to massive changes in travel behavior. As recovery from the pandemic occurs in fits and starts, whether and to what extent pandemic-induced changes in travel will persist remains in question. Major issues include whether telecommuting and e-commerce will remain popular and whether avoidance of shared modes will continue.

At the same time, new transportation options, from high-speed rail to bike sharing, are being added to California's transportation systems, and transportation technologies continue to evolve—electrification and automation are examples. Such changes need to be considered in plans that aim to steer actions for 20, 30, or even 50 years, along with other driving forces, including fuel prices and turnover rates for the vehicle fleet. How these factors are dealt with in plans can make a difference in how well the plans comport with actual experiences in the future.

The UC team has evaluated California's state and metropolitan transportation plans, financing for transportation, and the legal framework in this broad and uncertain context while taking into consideration the legacies of successive transportation technologies and the institutions that shaped and were shaped by them and the implications for change.

Research Methods

The UC team carried out its work based on 1) reviewing and analyzing previous research on the topic, including government reports, assessment document, and scholarly literature; 2) discussions with SGC staff and the staff of state agencies involved in transportation planning and related activities in California; and 3) interviews with key informants. A series of white papers was prepared to address the topics to be included in the report to the Legislature.

White Papers and Summary

Each white paper is designed to be read as a stand-alone document. In addition, a separate summary synthesizes the findings and recommendations.

Evaluation of California State and Regional Transportation Plans and Their Prospects for Attaining State Goals: Summary and Synthesis pulls together the key findings and recommendations of all the white papers. It assesses the prospects for achieving the state's diverse goals through its transportation planning and programming processes and identifies strengths and weaknesses of current policies and practices. It also provides the authors' recommendations for changes to policy and practice that could improve overall system performance and achievement of state goals for climate, equity, environment, safety, infrastructure, and the economy.

A Brief History of Transportation Policy and Institutions presents the development of transportation systems in the United States, with particular attention to California. The review includes key technological advances in transportation and the institutions that were developed to implement them. The paper also discusses the problem of organizational inertia and the issues associated with changing organizational culture to better reflect the problems of the day.
Review of Statewide Transportation Plans for California reviews the most recently adopted CTP and other key transportation plans adopted by state agencies, discusses the special attention given to new technologies in the CTP, and presents the findings from over 80 interviews with stakeholders across California who were asked to weigh in on the strengths and weaknesses of transportation planning practices in the state.

MPO Planning and Implementation of State Policy Goals evaluates California metropolitan planning organizations' regional transportation plans and sustainable communities strategies and looks at the relationship between MPO plans and what is actually funded through transportation improvement programs.

Examination of Key Transportation Funding Programs in California and Their Context assesses the congruence between funding programs and state goals for transportation. Particular attention is given to major funding sources, such the State Operation and Protection Program, and programs designed to promote key state goals, including the Affordable Housing and Sustainable Communities program, the Transit and Intercity Rail Capital Program, the Transformative Climate Communities program, and the Sustainable Transportation Planning Grant program.

Flexibility in California Transportation Funding Programs and Implications for More Climate-Aligned Spending examines key features of the legislative authority for transportation planning and finance in California, including local option sales taxes for transportation, and assesses the amount of flexibility that current laws and practices allow for reprioritizing projects as problems and priorities change.

Summary

This brief history of transportation focuses on transportation's developments in the United States, and in California in particular, over the past century. It outlines technological innovations and external events that shaped transportation systems and institutions. The key problems for transportation have changed from designing and building vehicles and networks with successive technologies to managing multimodal transportation facilities in a way that maintains and promotes a healthy environment, a vibrant economy, and social equity. Transportation organizations and their behaviors have been shaped by the transportation challenges of their time as well as by external events and shifts in political culture, but changes in organizational structure and culture have often lagged changes in the policies and priorities governing transportation planning and investment.

Ports and waterways, transcontinental, intercity and regional rail lines, urban and suburban transit systems, and bicycles all affected the location and form of the development of the United States. However, for more than 100 years, the internal combustion-engine motor vehicle has been the dominant vehicle technology. Although canals and railroads spurred westward expansions, and urban rail and trolley systems shaped many cities in the 1800s, automobiles and trucks, with their ability to go anywhere where there were roads, quickly captured the public imagination in the first two decades of the 20th century. In response to growing auto use, the states, with federal aid starting in 1916, improved roads throughout the first half of the 20th century. Gas taxes and other user fees were instituted to fund the building boom. During the 1950s and '60s, the federal government and the states funded and built an extensive network of highways designed for fast, safe mobility, including the Interstate Highway System (funded mostly with a 90 percent federal share).

As motor vehicles and improved roads proliferated, transit and rail lost substantial market share. Intercity rail and transit were especially hard hit after World War II, and service cuts, line abandonments, bankruptcies, and corporate consolidations became common. Along with federal housing programs that supported home ownership, new roads made suburban development feasible on a massive scale. Many jobs soon followed the move to suburban centers supported by highways. Failing transit systems disappeared or became public entities, and intercity passenger rail became the public service, Amtrak, leaving the privately owned railroads to mostly concentrate on freight.

Not every highway was well received. As urban freeway construction got underway, so did freeway protests in cities, including Boston, Atlanta, New Orleans, Memphis, San Francisco, and Los Angeles. Calls were made for more balanced transportation investments and for federal aid in rescuing faltering urban transit services. Starting in the 1960s, the federal government initiated a federal transit program and new transit systems, and system expansions were constructed in cities and suburbs across the country. The US Department of Transportation was formed, bringing programs for highways, transit, rail, aviation, and water transportation under one roof, and the states followed suit. However, federal and state transit programs were only a small fraction of the size of highway programs and were administered on a separate track.

Challenges to urban highway building were part of broader cultural and political changes in the United States in the 1960s and '70s. US Supreme Court decisions mandating "one person, one vote" districting in the House of Representatives and in state legislatures gave urban interests a larger say in political decisions. The civil rights movement, protests against urban renewal projects and highways, and anti-war protests challenged traditional decision processes and the role of "experts," with demands for equal treatment and more say in decisions affecting people's lives. In the 1962 Federal Aid Highway Act, Congress mandated that urban areas implement a continuing, cooperative, comprehensive transportation planning process led by local officials, and it directed that within those regions, only projects approved through that 3-C process could receive federal funding. Civil rights laws were enacted, prohibiting discrimination on the basis of race, religion, color, national origin, or sex. Environmental issues gained political traction, and requirements were instituted for environmental impact assessment and pollution control and abatement. Regional transportation agencies were given responsibility, together with air quality agencies, for reducing transportation emissions. The oil embargos in the 1970s fed inflation and led to the passage of energy conservation requirements, including motor vehicle fuel efficiency standards.

Beginning in the 1970s, highway construction slowed—most of the easy links had been built, the remaining projects were costly and often controversial, and inflation in construction costs had cut into purchasing power. By the 1980s, transportation facilities built in earlier decades were showing their age. Maintenance and repair activities took on an increasingly prominent role in many state departments of transportation (DOT). Anti-tax movements and the sense that highway building was reaching its limits made federal and state officials slow to raise the gas taxes, and when gas taxes were raised, they did not always keep up with inflation. While state DOTs and their organizations lobbied for an expansion of interstate-level highways, metropolitan planning organizations (MPO), transit operators, big-city officials, and environmental organizations pushed for more funding for transit, bike lanes, and pedestrian improvements, as well as more flexibility in spending and more money focused on regional needs and air quality problems. The Intermodal Surface Transportation Efficiency Act (ISTEA) provided some of everything: funding transit and highways in the same legislation for the first time, creating a somewhat expanded national highway system, and initiating new programs addressing the issues of concern to urban areas, with particular attention to air quality and other quality of life issues. The last federal gas tax was enacted two years later, but was not indexed to construction costs or general inflation, so it lost purchasing power over time.

In 1990, the Americans with Disabilities Act (ADA) was passed, building on previous laws, including section 504 of the Rehabilitation Act of 1973 and expanding the prohibitions of discrimination against individuals with disabilities. Meanwhile, concerns about climate change led to the 1992 adoption of the United Nations Framework Convention on Climate Change (UNFCCC), committing countries to reduce greenhouse gas (GHG) emissions based on the scientific consensus that global warming is occurring and that anthropogenic emissions are driving it. The UNFCCC was followed by the Kyoto protocol in 1997, a climate treaty that the US signed but did not ratify in the Senate. In the US, reports on environmental hazards visited on disadvantaged people and people of color raised public ire. In 1994, President William Clinton issued an executive order on environmental justice, directing federal agencies to prioritize, analyze, report, and address disproportionate adverse impacts on low-income people and communities of color. However, implementation of these environmental initiatives was mixed, at best. At the state and local level, efforts were made to create more livable communities by planning for pedestrian- and transit-oriented development, linking transportation to land use and environmental gains.

By the 1990s, new construction of highways had declined, revenues for highways were shrinking, maintenance and repair had become key functions, and land use, environment, social equity, and their linkages to transportation and development patterns were receiving increasing attention, although on-the-ground achievements remained spotty.

In the first two decades of the 21st century, transportation legislation at the national level received little attention, and its policy and program content remained largely unchanged from ISTEA, although the needs of freight transport were given added attention. A major issue throughout this period was the status of the highway trust fund, which required infusions from the general fund to stay afloat. In some cases, including California, state and local governments stepped up to fund transportation services locally and to adopt programs that combat climate change, reduce exposures to unhealthy air, and improve energy efficiency. For example, California created a cap-and-trade emissions program and dedicated part of the revenues to high-speed rail and part to the needs of low-income communities. In 2017, California's SB 1 (Beall) increased the gas tax and other state transportation levies, resulting in a doubling of transportation revenues from about $6 billion in 2016–17 to about $12 billion in 2019–2020, with about two-thirds of the money going to streets and highways.

New transportation options emerged over this period, ranging from cellphone-based information systems and ride-matching apps to increasingly automated vehicles and robots and drones for deliveries. Wildfires and other natural disasters underscored the need for greater infrastructure resilience and warned of the risks of climate crises. Concerns about racial justice accelerated after the murder of George Floyd and led to public agencies throughout the country issuing racial equity statements. Transportation agencies acknowledged that past transportation decisions divided communities and amplified inequalities, disproportionately impacting people of color and disadvantaged communities, and they pledged to do better.

The passage of the federal infrastructure bill in late 2021 substantially increased federal authorizations for transportation spending over the next five years. The new bill includes formula grants as well as competitive programs, and funds are identified for highways, transit, safety, active transportation, emissions reduction, and resilience, along with investment programs that will aid in electrification of the transport system. California's share of the funds, assuming that they are appropriated, is anticipated to be about $5.4 billion per year. Such an infusion of funds could not only support better transportation facilities and services but could allow states to finally keep promises of an equitable, environmentally sound transportation system.

Over the years, the organizations and planning processes devised to deliver and manage transportation systems reflected the problems, opportunities, and cultural beliefs of the times. To induce construction of canals, railroads, and highways, governments used land grants, eminent domain powers, patent protections, and government-funded research as tools. Regulatory agencies were formed to prevent price gouging and other unfair practices. The country's army engineering skills were tapped to build early canals and rail lines, and their military organization and management shaped public works organizations in building highways. Commissions were formed to oversee bureaucracies and infuse a business-like culture of cost management and efficiency into transport projects. Ballot-box measures were introduced to allow the people to have a direct voice in government. Metropolitan planning organizations were established to give urban areas more say about the major highway projects that were being built. Highway departments became transportation departments when federal government grants began to flow for transit and intercity modes and political leaders clamored for a balanced transportation system. Partnerships among transportation, housing, and environmental officials have been established to better coordinate development efforts. Still, in many instances, transportation organizations and institutions have been slow to fully respond to changes in technology and community values, clinging to preferences for building projects over managing systems, and treating community and environmental mandates as constraints or secondary issues rather than as cause for redirection. One result has been for legislators to limit state DOTs' authorities, mandating shared decision-making with regional and local agencies and, in some cases, assigning oversight to other organizations, as is the case for air quality programs.

The situation in California follows the same general outline as the rest of the US but with some notable features that make transportation policy and planning particularly complex. The auto-highway system became the dominant means of

travel in California over a century ago, and large parts of the state developed around motor vehicle transport. Driving is the mode choice for nearly 90 percent of the trips in California, including many trips under a mile in length. One result is a high level of emissions from internal combustion engine-powered transportation, which, with the topography and weather, combine to create persistent problems of air pollution. Traffic from the state's large ports travels through communities of color, leading to disproportionate harm from particulate exposures. Congestion slows many trips, increasing costs and making travel stressful.

The federal government apportions many transportation funds based on statutorily established formulas, as do many states, but California has developed a particularly complex set of rules with north-south splits and county minima as well as allocations based on population, lane miles, tax revenues generated, and other factors. California's system of voter initiatives made it possible for anti-tax sentiments to be established as state constitutional law, which has made it difficult both politically and numerically to get the votes to raise taxes. Shrinking state funding for transportation created the impetus for local self-help in the form of local option sales taxes: voters can choose to tax themselves for specific programs and projects at a specified rate for a specified period. Local option sales taxes agreed to by voters and implemented at the county level (and later, in some regions) have become a major funding source for California transportation projects. The county expenditure plans vary in specificity, but the political commitments behind them make it hard to shift priorities.

Over the past several decades, California has also created a complex institutional structure for transportation, more by accretion than by explicit strategy. California MPOs have been given greater authority than in most states over the projects that are programmed for detailed development and funding, but they are expected to incorporate County Transportation Authority programs over which the MPOs have little say. The MPOs have been assigned responsibility for implementing Sustainable Communities Strategies—transportation and land use strategies designed to meet ambitious GHG reduction goals—but not the authority to require localities to implement them. While MPOs do have some funds that can be used to incentivize local action, such funds are limited. The state DOT, Caltrans, prepares a state transportation plan and programs interregional projects, but it notes that it fills the gaps between the regional plans and does not mandate policy changes or specific actions at the regional level. Caltrans reports to a cabinet-level transportation agency (CalSTA), but also responds to the California Transportation Commission, which develops fund estimates and guidelines and approves programming (the projects that will be developed and funded). The legislature has limited the California Transportation Commission's authority to modify Regional Transportation Improvement Programs and, as part of a recent gas tax increase devised by the legislature and approved by voters, has established a separate audit function. Together with Caltrans' highly decentralized organization, where many decisions are devolved to district office, it can be very difficult to steer investments in a different direction and even more difficult to change transportation agencies' culture—their views of what needs to be done.

Still, California has been a leader in addressing transportation problems. Since the 1950s, California has conducted path-setting research on air pollution and its relation to transportation and other sources, and the state has developed programs to address the pollution problem. California also established an environmental impact statement law that is more encompassing and often more consequential than the National Environmental Policy Act. In addition to highway building, the state has funded new transit systems and intercity rail services, mandated clean fuels and vehicles, led research and development on automation and other advanced technologies, better operations, demand management, and coordinated transportation and land use planning. These measures are among the tools that the state is using to contend with congestion, pollution, and safety problems. California has also used bridge tolls and high occupancy toll (HOT) lanes to manage demand, and California companies have been leaders in offering ride-matching and micromobility innovations. However, growing population and economic activities pose a challenge, because growth could outstrip technology and policy gains.

Today, it appears that transportation is on the cusp of another technological innovation, and another round of institutional change might also be in the offing. Opportunities to rethink planning processes for urban development are being tested around transit stations, along major corridors, and in areas in need of reinvestment. These strategies can be thought of as experiments in integrating transportation and land use planning with a focus on equity and environmental quality. The question remains whether additional institutional reforms could improve project design, selection, and delivery processes in this new paradigm.

1. Introduction

This paper presents a brief history of transportation as it developed over the centuries, focusing mostly on the United States, and in particular, California. Special attention is given to the role of transportation technologies and to the institutions that plan, design, build, and operate transportation. The purpose of this paper is to provide context and extract lessons for understanding and evaluating current transportation issues and possible responses in an era characterized by serious challenges—the COVID pandemic, climate change, economic and governance uncertainties—as well as newly emerging opportunities for addressing those challenges.

The paper begins with an outline of key developments that have shaped transportation, often involving technological innovations, but also punctuated by catastrophic events. Brief mention is made of other inventions (such as the creation of a patent system) and other programs (such as housing) that condition transportation programs and their impacts.

Transportation has always been a public-private affair, with shifting boundaries of responsibility. The institutional section of the paper focuses primarily on how the public organizations that oversee transportation in the United States were established and assigned responsibilities that reflected the issues of the time. The discussion covers the formation of state highway commissions and highway departments and their transformation into departments of transportation (DOT) with broader transportation responsibilities, and the move from privately owned passenger transportation services to public transit agencies. Additional topics are the formation of metropolitan planning organizations (MPO) and their particular roles in California, especially since the passage of SB 375, and the roles of local agencies and their linkages to MPOs and special-purpose transportation agencies.

The paper concludes with a discussion of strategies that aim to better coordinate state and regional transportation planning and to reform planning culture and practices to deal with transportation as an element of larger statewide, urban, and regional planning processes.

2. Research Approach

This paper is based on a review of the literature on transportation history and the author's prior research documenting highway and transit histories in California and nationally (Deakin, 2002; Deakin, 2006; Deakin and California Transit Association, 2015; Deakin, 2019). Any topic discussed here could be the subject of book-length treatment, but for the purposes of this paper, it was necessary to be selective. Technological innovation, disruptive events, and changing policy perspectives, both within the transportation field and external to it, were the themes chosen for primary attention. An outline of issues was prepared, and one-on-one discussions with four academics who have written on the themes of the paper helped to identify additional topics to consider. Discussions with several scholars and professionals working in the fields of transportation history, transportation institutions, and organizational behavior helped shape the interpretation of events and their implications. Interviews conducted for the review of state and regional plans also informed portions of this paper.

3. A Brief History of Transportation

The appendix at the end of this document presents a timeline of transportation milestones, practices, and events, along with a few external events that have had significant impact on transportation. Here we present an overview of the changes in transportation systems that have taken place over the centuries (Garrison and Deakin, 1992; Rodrique, 2013; Deakin, 2015; Deakin, 2020; Warner, 1978; Weiner, 1984, 1985, 1992).

Early Years

For millennia, most transportation was by walking, by water transport, or for those who could afford it, using animal power. Ferry services and animal-drawn conveyances for hire made early appearances in a number of countries. Roads were built but were mostly unpaved, and travel on them was arduous and risky. Canals became an important means of connecting natural waterways and bypassing hazards. In a number of countries, canals were widely used for transporting goods, and in the US, the Erie Canal sped the development of midwestern territories.

Overlapping with canal building, in the late 1700s and early 1800s, were the first attempts to build roads capable of moving wagon loads of goods without rutting. A few post roads were supported by the federal government and helped early settlers move west. However, most road improvements were made by local governments who depended on labor provided by the local populace. Turnpikes were built in the early 1800s in a number of eastern states, privately constructed and supported by tolls and local residents' investments (Deakin, 1989–90). In California and the Southwest, hard-surface roads were built between the Spanish settlers' haciendas and to ports and river connections, and then to inland settlements where mining, forestry, and agriculture were booming. Still, road building was costly and arduous, and therefore improved roads were few and far between.

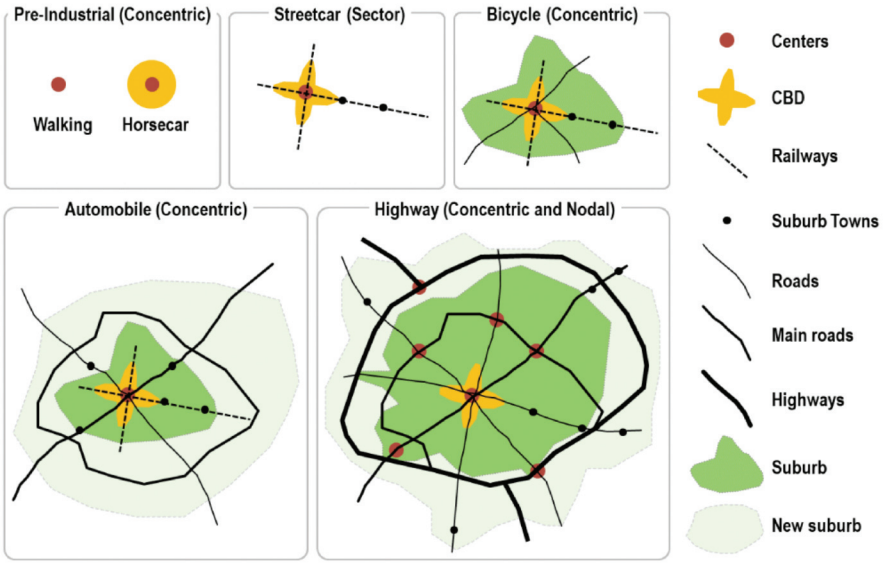
Soon however, the steam engine began to change transportation in significant ways. First steamboats were developed, and steamships began to replace sailing ships. Then steam-powered engines powering carriages over rail lines began to emerge. Rail transport was far faster than canals and became the dominant means of long-distance transport, although canals remained in use as adjuncts to natural waterways.

The development of railroads in the 1840s brought a fast, safe transportation option, opened up the Midwest to rapid development, and eventually led to an intercontinental railway commissioned by the federal government and supported with government bonds and massive land grants. While initially short lines connected canals to rivers and ports, longer railroads soon outcompeted the slower canal and river services, and water transport shrank. However, railroads' discriminatory access and pricing practices led states and then the federal government to regulate railroad practices. The Interstate Commerce Act and its state counterparts were the first instances of regulation of a major industry in the US. Subsequent regulations extended to labor relations and to mergers and service abandonments.

Interest in rail transport was also evident in cities. Intercity trains offered freight and passenger services, and commuter towns developed around stations in a number of urban areas. In the late 1800s, many cities franchised private operators to provide local rail services, with streetcars first drawn by horses and later powered by electricity. Electric power also made subway systems safer and more practical, and underground deployment helped to reduce the congestion that characterized many city centers. Streetcar suburbs were enabled by transit connections, greatly expanding the physical size of cities. In many cities, developers were major proponents of the urban rail systems because of the access that they provided to developable land at what was then the urban edge (Warner, 1978).

Toward the end of the 19th century, another technological breakthrough, the safety bicycle, entered the market. With wheels of equal size, a chain drive, and eventually brakes, the new design made bicycles safer, fast, and comfortable. Bikes were affordable for many, and a bicycle boom took place. Cycling made independent travel over ranges of up to five miles available to large numbers, and both men and women joined in. With cycling, the land between the streetcar lines became accessible and supported wider development. The biggest barrier was the poor quality of most roads, which were unpaved and potholed. Cyclists demanded better pavements, and they became early lobbyists for good roads (Friss, 2015; Rodrique, 2013).

Figure 1. Evolution of urban form with respect to mobility and land use



Source: Jean-Paul Rodrique, 2013

Motor Vehicles and Transit

The late 1800s, about the same time that electric trolley systems were being built in cities across the US and cable cars began to offer service in San Francisco, also was the period during which the automobile was being developed. While designs for engine-driven vehicles stretch back to Leonardo, it was the technology developments of the mid-1800s that produced practical vehicles. Early automobiles, hand-built and expensive, appeared in the late 1800s, powered variously by steam, electricity, and gasoline. It was Henry Ford's Model T, built on an assembly line, that enabled mass production of vehicles at prices that middle-income households could afford. During the 1920s, nearly 30 million automobiles were built and sold in the US. Cars began to compete with transit systems and motorized trucks with delivery carts and rail services.

Roads remained a problem, however: In 1904, only 4 percent of the US roadways were paved. Advances in road design and paving materials made hard surfaces less costly than in earlier years, but the growing demand for better roads put severe pressure on state and local budgets. With demands for road funding exceeding half of the total budget in many states, good government movements of the era advocated the establishment of highway commissions to provide business-like oversight of investments. Oregon was the first to address the financial pressures with a gas tax, and other states followed. By 1926, all states and the District of Columbia had adopted a gas tax. In most cases, the tax was dedicated only to highways.

The federal government, which had supported rail expansion through bonds and land grants 50 years earlier but had largely withdrawn from road building in the early 1800s, began to show interest in roads again in the late 1800s. A first move was the establishment of the Office of Road Inquiry in 1893. Congress later funded a "good roads train" demonstrating highway engineering best practices throughout the country, created a national inventory of roads, and established a one-year engineering training program.

With states clamoring for more federal assistance and auto ownership booming, the federal government responded with the 1916 Federal Aid Highway Act. It offered grants for highways, provided that states match federal funds dollar for dollar, and required states to create a state highway department that was technically skilled, managed in accordance with the principles of scientific administration of the day (which was derived from military hierarchical management), and authorized to supervise the expenditure of the funds. The federal government also established research and testing facilities and helped to support the establishment of the Advisory Board on Highway Research, which became the Highway Research Board in 1924 and the Transportation Research Board in 1974.

The Federal Aid Highway Act of 1921 required the states to establish a system plan for highways to be eligible for federal aid, work that was completed in 1923. Through the 1920s, many parkways and scenic highways were built. Funding for these projects came from general revenues. A gas tax was proposed several times during the Wilson Administration, but did not win support. It was not until 1933 that a federal gas tax was established to help pay for the programs. It has subsequently been increased 10 times, most recently in 1993.

With the Great Depression, federal aid was suspended, and funds redirected toward recovery. Nevertheless, many work projects were for highways. Culverts, bridges, and paving projects, many of them aimed at "getting the farmer out of the mud," were implemented across the nation. For these projects, standard highway designs were promulgated through official design manuals, and public works staff were expected to do their work "by the book." Yet monumental infrastructure requiring engineering innovations were also built during the Depression, including Hoover Dam and Bonneville Dam and, in California, the San Francisco–Oakland Bay Bridge (1936) and the Golden Gate Bridge (1937).

It was also during the 1930s that the first efforts were undertaken to build a system of limited-access highways across the US. Study tours to Europe led to reports to Congress about the autobahn and roads in England and France. The 1939 report to Congress, *Toll Roads and Free Roads,* contained the first formal concept of the Interstate Highway System, but how to pay for it was a puzzle, and many states were concerned that there was still much to be done to improve the designated networks of primary highways and rural roads. The onset of World War II paused the discussion, because fuel was rationed and manufacturing was redirected from cars to military equipment.

As early as the first decade of the 20th century, the private enterprises offering intercity rail and urban rail transit began to lose market share, and many rail and transit companies failed. Expanding auto use and improved highways were a significant factor, but overexpansion and excessive economic regulation also contributed to the failures. A few transit operations were taken over by municipalities, including the San Francisco Municipal Railway. Others disappeared, or the

rail services were replaced by buses. These trends were exacerbated by the exigencies of the two world wars and the Depression, when investments in rail systems nearly ceased.

Post-War Highway Building, Suburbanization, and Public Transit

After the war, the economy boomed, and auto purchases and auto use skyrocketed. State and federal governments invested massively in highway building, with the Interstate Highway program (which commenced in 1956) the most visible achievement. The interstate facilities were funded by a federal gas tax reserved in a Highway Trust Fund, and the federal government picked up about 90 percent of the cost. The greatly expanded system of motor vehicles and highways offered fast, safe, efficient, and convenient transportation for both passengers and freight. Reduced costs of transportation improved productivity. Beltways and radial highways brought locations far from traditional job centers into acceptable commute range, supporting urban agglomerations geographically larger than before. United States became a suburban nation, and many of the new suburbs were developed without sidewalks and with little or no transit service, but with plentiful parking for automobiles (Duany et al., 2005; Jackson, 1985).

Highway building was not always happily received, however (Deakin, 2006). As early as the 1950s and continuing through the '70s, freeway controversies roiled San Francisco, Boston, New Orleans, Memphis, Los Angeles, and Atlanta. Civil rights activists took to the streets to protest discrimination in transportation, housing, and voting, and in 1964 and 1967, landmark Civil Rights Acts finally were signed into law. Adverse community and environmental impacts of transportation systems also became matters of public consternation and protest. In 1969, the National Environmental Policy Act (NEPA) was adopted to mandate consideration of alternatives and disclosure of adverse impacts from federally assisted projects. Numerous state governments followed suit with their own versions of NEPA. Studies in the 1950s and '60s produced evidence linking auto emissions to unhealthy air, and the federal Clean Air Act Amendments of 1970 addressed the problem by mandating emissions controls on automobiles and industries and calling for additional transportation controls in areas that still couldn't meet health standards. Studies decrying the costs of sprawl made the news, and while scholars recognized that many factors had contributed to the outward expansion of urban areas in the postwar years—continuation of trends that had been started by streetcars, growth in the population and the economy, increased prosperity, lower land costs and less regulation at the periphery, policies supporting home ownership, subsidized water, power, and related infrastructure, lifestyle preferences, de facto and de jure segregation—the role of highway programs in enabling sprawl was often emphasized (Figure 1). The Arab oil embargo of 1973, and a second embargo in 1979, led to uncertain fuel supplies and unstable prices, adding to concerns about auto dependency.

Meanwhile, transit companies were struggling. Although transit use was high during the war, ridership declined as car ownership and use grew and residents moved to the suburbs. By the late 1950s, many state and local governments were implementing public takeovers and consolidations of weakened systems (Jones, 1985). In the early 1960s, the federal government stepped in, first with capital grants, and later with operating assistance. Soon federal assistance was enticing many cities to invest in new transit systems, but this time the policy was implemented with public dollars and, with few exceptions, without a specific link to development around the stations. Programs promoting carpooling, vanpooling, subscription bus services, and dial-a-ride paratransit services were also offered in many urban areas (Meyer, 1999; Ferguson, 1990). Still, auto ownership and use continued to grow, and by the time the Interstate Highway program began drawing to a close in the 1980s, many of its facilities were in need of significant repairs and experienced heavy congestion (Choate and Walter, 1983; Saltzman, 1992). Federal leaders commissioned studies on what to do about infrastructure, air quality, and finance options, while extending the policies of the '50s, '60s, and '70s and earmarking funds for numerous projects that they wanted to see built in their home states and districts.

At the same time, new transit systems were experiencing cost overruns and falling short of ridership projections (Pickrell, 1992; Kain,1990; Flyvbjerg et al., 2002), leading some to question whether transit could play an important role in urban development in an era of near-ubiquitous highways and autos (Giuliano, 1995, 2004). Unlike highways, which had a dedicated public funding source (gas taxes placed in trust funds), public support for transit mostly came from general funds or local sales or property taxes, and in many cases, this was seen as a problem. Some viewed the problem as one of too little investment in transit systems and services for it to be competitive, while others viewed transit as an outmoded technology whose decline needed to be managed and its costs contained. Performance measures were instituted along with reporting systems, such as the federal Section 15 transit data reporting requirement.

ISTEA and Its Successors

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) amounted to a major change in transportation policy. It took a multimodal approach to transportation planning and funding, created programs focused on congestion relief and air quality improvement, mandated performance monitoring for highways and bridges as well as transit, and gave significant additional powers and responsibilities to metropolitan planning organizations.

ISTEA was followed by an increase in the federal gas tax in 1993. After that, until just this year (2021), there was very little change in federal transportation policy and a declining level of funding in real terms. After ISTEA, action on subsequent legislation—the 1998 Transportation Equity Act for the 21st Century (TEA-21), the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), and the 2012 Moving Ahead for Progress in the 21st Century (MAP-21) Act—was often delayed or extended for a few months at a time as Congress could not agree on levels of funding or what to do about the declining balance in the Highway Trust Fund. Overall, federal legislation from ISTEA onward continued to primarily fund highways while providing smaller sums for transit, bicycle and pedestrian facilities, multimodal planning and projects, and air quality improvement programs. Funding and requirements for freight projects were significantly expanded, but the overall sums remained modest. MAP-21 eliminated congressional earmarks, but with the Great Recession of December 2007 to June 2009, a new discretionary program for Transportation Investment Generating Economic Recovery (TIGER) grants was authorized with the American Recovery and Reinvestment Act of 2009, allowing transportation projects to proceed.

From a federal perspective, by 2020, transportation policy had been stalled for years. The Interstate Highway program had been authorized almost 70 years previously and had been deemed completed three decades past. Five decades had gone by since federal laws promoting transit and aiming to reduce the adverse impacts of an auto-dominated transportation system went into effect, and three decades had passed since ISTEA established a multimodal framework for transportation aimed at reducing congestion, supporting economic development, and improving the environment. Congress through the first decades of the 21st century could not agree on tax increases for transportation and, for the most part, continued the ISTEA framework in subsequent federal legislation. Meanwhile, the federal gas tax's buying power had eroded by 44 percent since its 1993 increase, and the Highway Trust Fund was kept afloat through infusions of general funds.

With federal funding for transportation stagnant and federal action erratic, state and local governments had been taking on larger roles from the 1980s onward, raising taxes through a variety of mechanisms, including gas tax increases, local option sales taxes dedicated to transportation, and public-private partnerships. For example, California jurisdictions adopted numerous county transportation taxes, and the California Legislature passed legislation and secured voter approval for funding for a variety of projects ranging from high-speed rail to highway maintenance funds. State and local governments also stepped in to take action on climate, with California and northeastern states pioneering climate and

clean-energy programs as well as actions to reduce transportation emissions. While many transportation groups continued to push for renewed federal involvement, some (e.g., Poole, 2009; Biehl, 2021) advocated for devolution of authority over transportation programs to the states, along with a return of federal gas tax money—a recurrent theme since at least the 1980s, but one underscored by the seeming inability of Congress to agree on a new bill.

The 2021 Bipartisan Infrastructure Bill—New Directions?

Today, there is the prospect that big changes are coming to the transportation field. The new federal Bipartisan Infrastructure Law (BIL), signed into law in November 2021, includes $550 billion for transportation investments, ranging from roads to rail to electric vehicles and charging infrastructure. Additional funds are authorized for improving the electricity grid and providing resiliency, actions that would assist transportation programs. While federal transportation agencies will issue new guidance and regulations to fully implement the bill's legislative changes and new programs, agencies are already signaling what they will emphasize. The Federal Transit Administration (FTA) has identified its priorities as safety, modernization (including state of good repair), climate (emphasizing green vehicles), and equity (improving transit service for communities that have historically had more limited access to transit and providing for substantial upgrades to station accessibility) (FTA, 2021).

A newly issued Federal Highway Administration guidance document (FHWA, 2021) states:

> "Investments and projects that align with the BIL and will help Build a Better America include those that:
>
> - Improve the condition, resilience and safety of road and bridge assets consistent with asset management plans (including investing in preservation of those assets);
> - promote and improve safety for all road users, particularly vulnerable users;
> - make streets and other transportation facilities accessible to all users and compliant with the Americans with Disabilities Act;
> - address environmental impacts ranging from stormwater runoff to greenhouse gas emissions;
> - prioritize infrastructure that is less vulnerable and more resilient to a changing climate;
> - future-proof our transportation infrastructure by accommodating new and emerging technologies like electric vehicle charging stations, renewable energy generation, and broadband deployment in transportation rights-of-way;
> - reconnect communities and reflect the inclusion of disadvantaged and under-represented groups in the planning, project selection and design process; and
> - direct Federal funds to their most efficient and effective use, consistent with these objectives."

The document goes on to state that FHWA will encourage, or where law allows it, require that repair, maintenance, and operations be considered before new capacity is added. Forthcoming regulations aim to

> "improve safety and accessibility for all road users, reduce the environmental impact of highway and bridge projects, including curtailing transportation greenhouse gas emissions that contribute to climate change, better accommodate new and emerging transportation technologies, reduce relocations and otherwise ensure that transportation agencies do not expand roadways in inequitable ways that disproportionately impact disadvantaged communities, and support the efficient and effective use of Federal funds."

The likely direction of the programs is further underscored by the Biden Administration's commitment to reduce GHG emissions by half or more from 2005 levels by 2030 and to reach net-zero emissions by 2050.

The new federal legislation has the potential to significantly change the direction of transportation investments in the coming years, with greater emphasis on maintenance and operations, multimodal investments, environmental protection, social equity, and cost-effective project choices. The new legislation comes at a time when new transportation offerings are increasingly in evidence and more are under development. These new hard and soft technologies, which range from app-enabled ride-matching services to electric-powered cars, trucks and buses, could transform transportation over the next three decades. Increasingly, vehicles include driver-assistance technologies, and autonomous vehicles are on the horizon. Together with increased use of sensors and other technologies to monitor highways and other transportation facilities, safety and security improvements seem within reach. While there is no doubt that emerging transportation technologies will increase the options available for passenger and freight transport, offer the potential to greatly reduce emissions, and deliver other benefits, how they are implemented—and the public policies that govern that implementation—will determine whether they increase or reduce congestion and safety (Sperling et al., 2018).

Changes also could be coming in urban land use patterns. Urban land uses and development patterns have long been understood to play an important role in transportation planning because they affect the number of trips generated, their spatial and temporal patterns, and the modes used. However, until relatively recently, most transportation plans did not consider transportation investments' effects on location and land use, on the grounds that land use decisions were not the transportation agencies' responsibility. Yet research has repeatedly shown that the types of transportation investments being made and their location affect land development patterns. Indeed, changing location and land use has been the explicit purpose of many transportation investments, from the streetcar lines that opened up new areas for suburban development in Los Angeles, the Bay Area, and across the globe to the highway projects built to support industrial development and attendant jobs (Warner, 1978). Post–World War II highways have supported suburbanization, massively affecting the location of residences and employment centers (Jackson, 1985; Cervero, 1989; Nelson, 2017). Accounting for these two-way impacts has led to a recognition that access can be provided by proximity as well as through transportation and that transportation accessibility and mobility can be provided by many different modes, some with less adverse impact than others.

Today, an increasing number of transportation agencies aim to coordinate their work with land development. They have improved analytic methods to better reflect transportation-land use interactions. They are seeking joint projects with developers to help finance transport facilities and working on areawide transit-oriented development plans with local governments to increase transit ridership and overall community benefits. In US cities and states where housing shortages and price increases are posing severe problems, planners and developers are pursuing opportunities to increase densities, mix uses, and improve urban designs to encourage nonmotorized travel and transit use (Calthorpe, 1993; Cervero and Kockelman, 1997). They also are reusing outmoded commercial properties while simultaneously redesigning streets for multimodal access and greater safety, addressing transportation and land use problems together (Blanco, 2021). In states like California, where laws are already in place calling for plans and projects that link transportation and land use, there are real possibilities for delivering land use-transportation-environment benefits as a package (Deakin, 2017). However, displacement of existing residents and businesses (directly or indirectly whether by highways, transit, or other modes of transportation) has been an issue for many decades and can create serious equity problems (Zuk et al., 2015), and as the problem was recognized in planning for transit-oriented development, efforts have been directed toward strategies to avoid these adverse effects.

Equity is also resurgent. While civil rights laws have banned discrimination in transportation for decades, the rights of people with disabilities have been underscored since the passage of the Americans with Disabilities Act in 1990, and since the Clinton Administration, federal agencies have been directed by successive executive orders to take steps to avoid disparate impacts and promote environmental justice, social equity promises are still unkept (Huang, 2014).The murders

of George Floyd and Ahmaud Arbery and the botched police raid in which Breonna Taylor was killed, all in 2020, led to widespread protests against systemic racism in the United States, and throughout the US, many public and private organizations issued statements acknowledging past harms and pledging to do better. For transportation agencies, this will mean redress of disparate service levels and exposures to pollution, climate change, community disruption, and displacement. The FHWA guidance document cited earlier also underscores the need for compliance with ADA.

4. Transportation Institutions and Their Evolution

Transportation institutions—by which we mean organizations and their relationships, as well as the norms that they embody and the practices they follow—have both shaped and been shaped by national and international developments and technological changes.

The brief history of transportation presented in the previous section emphasized the role of successive technological innovations in transforming transportation systems. In the US, these technological breakthroughs and dominant technologies are sometimes referred to as "ages" or "eras": the Age of Canals and Turnpikes, the Railroad Era, the Age of Transit, the Era of Autos and Highways.

It was noted that when first introduced, the innovations competed with established technologies, but over time, market shares shifted toward the new mode and then tended to stabilize. This is consistent with theories and empirical evidence from a variety of fields on the diffusion of innovation, which find that a technological breakthrough typically initiates an era of intense technical variation and selection, culminating in a single dominant design, followed by a period of incremental technical progress (Rogers, 1962, 2010; Abernathy and Utterback, 1978; Utterback and Suarez, 1993; Anderson and Tushman, 1990). The research in this area also recognizes that technological change is embedded in a social system and dependent on communication and social learning (Rogers, 1962, 2010).

Technological Change and Organizational Behavior

Innovations in turn affect organizational behaviors, formally and informally—they result in the adoption of new policies and procedures, but also alter tacit norms and criteria for decisions and actions. If the innovation is mostly consistent with existing institutions, it often can be absorbed with little change. If it requires new organizational competencies and new processes, organizational change at a larger scale might be necessary (Rogers, 1962, 2010; Mansfield, 1995; Lundblad, 2003).

Organizational change can come easily or with considerable resistance. Change will come faster and more readily if the change is compatible with established norms and processes and does not require other, coincidental changes. Innovations that are intentionally spread, including by political mandate or directive, are also likely to be accepted faster than those that are simply made available. In addition, the demography of the organization, internal and external interpersonal relationships and networks, and how power is held and wielded within the organization all can support change or impede it (Pfeffer, 1985; Pfeffer, 1992).

The ability of organizations to adapt to new circumstances or incorporate change can depend on the strategies used to achieve it, and the effectiveness of various change strategies can be context-dependent (Kotter and Schlesinger, 1979; Bridges, 1991; Coetsee, 1999; Furst and Cable, 2008). Organizations can feel pressured to change from internal forces or from the wider environment (for example, the profession or the community), but in either case, the strength of the signal—for example, the number of advocates for change and their human capital—affect acceptance (Dowling and Pfeffer, 1975; Aldrich and Pfeffer, 1976). In complex environments where there are multiple channels for communication and multiple networks of association, differing views can block the innovation message (McCullen et al., 2013). Resistance to change can also reflect ambivalence and, in some cases, can be pushback against bad ideas (Strebel, 1996; Dent and Goldberg, 1999; Piderit, 2000; de Jager, 2001).

These findings for how organizations develop and how they change stem primarily from the study of private organizations, but most also apply to public organizations. However, public organizations exhibit several particular characteristics that must be kept in mind. Because most public organizations rely on taxation and other involuntary payments rather than the arms-length exchanges that characterize most private sector transactions, democratic societies demand a higher level of accountability and responsiveness to the public will than that expected of private companies. Also, while the ability to cover costs and return a profit are the key indicators of success for private organizations, public organizations generally must address multiple objectives in providing goods and services that support and improve public well-being, and the measurements of success often go well beyond the financial.

Transportation agencies, most of which are public, thus can be expected to exhibit most of the same organizational behaviors that have been identified in the literature but with the added mandates for accountability and increased complexities of performance measures.

While technological change in transportation has created change in transportation institutions, it has done so with difficulty when systemic transformational organizational change is needed, because such change is more likely to trigger resistance (Furst and Cable, 2008). Practices are developed to handle a particular problem of the time or one posed by the specifics of the dominant technology. These practices become embedded in organizations and rooted in the organizational culture, hardly questioned unless and until significant pressures are mounted for change. If the change only substitutes one technology for another and does not require other major changes in the organization or its practices, the change is likely to be accepted. But when a change requires widespread organizational modifications, implementation will likely be difficult (Strebel, 1996), and by disrupting established relationships, it can even lead to strengthened resistance (Avelino and Rotmans, 2009).

Transportation organizations often learn about innovations through communications with peers and sometimes internally as staff with new ideas and information join the organization. In many cases, the sharing of success stories and the ability to directly observe positive outcomes from the change can speed its adoption and the organizational changes that are needed (Marsden et al., 2011). However, the news of failures can also spread and block adoption (Lovell, 2017).

Pressures for organizational change in the transportation sector also have come from interest groups that seek to reform or redirect transportation policy. Such views can be reflected in new laws or executive directives. However, even when legal mandates are imposed or leadership points in a new direction, change can be slow to take hold if the message is mild (for example, if "directives" only apply if the implementers assess the actions to be "feasible"). Further, changing leadership can result in changing messages, with the result that skeptics often feel that they can wait for the political winds to shift again.

Decentralization of authority can also make change slower and harder to see through to implementation if counter pressures are present. Counter pressures can come from labor, professional organizations holding to previous practices, or clientele (for example, headquarters priorities that are at odds with local commitments). Positive and negative lessons are learned from peers and can affect the changes adopted and those resisted. Political philosophies about the appropriate role of government and the efficacy of market mechanisms versus collective action also color the interventions that are made.

Engineering Know-How and the Establishment of Highway Departments

Looking at the successive eras of transportation development in the US, we can trace the evolution of its institutions and the ways technological innovations, cultural values, and political exigencies shaped them. (Catastrophic events, such as wars, severe economic downturns, and pandemics also have had their impacts.) During the canal and turnpike era and into the rail era, engineering knowledge was nascent and highly empirical. Transportation engineering developed from military know-how, with West Point graduates offering leadership in early canal and rail building. Many of these soldier-engineers became leaders of the transportation organizations that ran the new transportation systems, and they borrowed practices from the military in designing transportation agency structure and management. Highway agencies and public works departments established similarly hierarchical structures when they were established and developed numerous policies, procedures, and design manuals to maintain consistency, which was highly valued.

Initially, the highway commissions and departments created as automobiles became numerous were expected to "get the farmer out of the mud" and create a network of highways of uniform design crisscrossing the country, and they staffed up and organized accordingly. Other modes were managed by separate, often private, organizations. The Interstate Highway program energized state highway departments and led to substantial expansion, while further solidifying policies and procedures with uniform design and operation. Although a few public intellectuals (Lewis Mumford, Daniel Patrick Moynihan) challenged this approach, especially for urban highways, it initially appeared that support for the fast, safe, efficient new designs was widespread. But as construction intensified in urban centers, protests erupted, challenging these practices and putting pressure on the institutions that for many decades had focused on delivering infrastructure as directed.

Adding Transit to the Mix and Sharing Responsibilities with MPOs

During the same period, the institutional structure of public transportation was changing rapidly and putting pressure on government coffers, especially in the large urban areas where transit use was highest. Transit operators, in early years mostly private companies, lost market share as auto use grew and public takeovers became commonplace in the 1950s and '60s. Passenger rail lost market share to air, and the railroads, by that time highly regulated, began to lose money. Urban interests and some of the states began to press Congress to step in with assistance. However, the first federal funds for transit came not from transportation funds but as part of community development and urban renewal projects (Smerk, 1992; Saltzman, 1992).

As priorities shifted to put more emphasis on urban transit and to consider potential synergies and tradeoffs across the modes, concerns were increasingly voiced about highway agencies' limited scope and their uncompromising insistence on uniform designs. Eventually this led in the 1960s to the creation of federal requirements for a continuing, cooperative, comprehensive (3-C) regional transportation planning process overseen by local elected officials (Wetzel, 1965; Weiner, 1992). State highway agencies at the time were seen as dominated by rural interests and insufficiently responsive to

urban perspectives. A regional approach was seen as better matching commute patterns while incorporating the local knowledge that city and county officials could bring to the table.

A number of urban areas had regional planning agencies or associations of government staffed by regional planners. These organizations had been established as a forum for dealing with a variety of urban issues that crossed local jurisdictional boundaries, including planning for regional sewer and water systems, regional parks, and the comprehensive general plans funded at the time by federal housing programs. In many areas, the regional agencies took on the urban transportation planning mandate and led the 3-C transportation planning process for the region. The 3-C planning process thus became embedded in an organizational framework based on regional planning agencies overseen by local elected officials (Johnson, 2004; Weiner, 1984, 1985).

The delegation of authority for regional transportation planning was not popular with a number of state highway departments, who saw it as a usurpation of their authority. While federal law mandated that the regions sign off on projects within their boundaries, some state transportation agencies found a way around this regional veto by refusing to provide matching funds for locally desired projects until the MPO agreed to approve the projects that the state agency wanted. In other cases, a highway or transportation commission simply overruled the MPO. One result of this maneuvering was to lock into place a level of distrust among the transportation agencies.

A few years after the 3-C process was initiated, institutional changes were made to highway departments: Highway departments and other modal agencies were reassigned to newly formed departments of transportation. The federal DOT was established in 1967, and many states created their own DOTs in short order. For example, the California Department of Transportation was established in 1972. However, simply housing the modes under one organizational roof did little to integrate their activities, and despite exhortations from then-Secretary of Transportation John Volpe, who as DOT secretary advocated "balanced" transportation systems and put a stop to urban highway projects that he had advocated years earlier as FHWA administrator, transit and highway planning remained on separate paths, and transit funding remained a small fraction of the funding provided for roads. Airports and airway, marine transport, and intercity rail planning and programming each had their own administration within DOT but were almost entirely disconnected from urban surface transportation activities.

Over the years, 3-C planning organizations came to be called metropolitan planning organizations (MPO), and the MPOs gradually were given greater authority over transportation planning and programming within their boundaries. When federal funding programs were first created, the transit agencies (usually city or county agencies, but sometimes special districts) dealt directly with federal transit authorities for funding. Gradually, however, they were brought into MPO planning and programming.

Environment, Energy, and Equity Concerns

Starting in the 1960s and '70s, environmental legislation, such as NEPA and its state counterparts (in California, CEQA), expanded the responsibilities of transportation agencies, requiring that alternatives to the proposed action be considered and impact assessments publicly reported. The Clean Air Act Amendments of 1970 established national ambient air quality standards and required states to develop implementation plans for attaining them, including transportation control plans in the event that regulations on transportation vehicles proved insufficient to meet the standards by the deadlines. After state air pollution agencies had difficulty devising feasible and effective transportation control plans, the 1977 Clean Air Act Amendments provided measures to be considered, and MPOs were given

responsibility for evaluating their effectiveness and proposing measures for implementation. Since then, MPOs have continued to play a role in air quality planning (Goldman and Deakin, 2000).

Oil embargos and sharp oil price increases in the 1970s raised concerns about transportation's dependence on petroleum-based fuels. Federal energy conservation legislation enacted motor vehicle corporate average fuel efficiency (CAFE) standards. Fuel efficiency standards greatly increased automobiles' miles per gallon performance, but even though the number of motor vehicles in use and the vehicle miles traveled (VMT) increased, fuel tax revenues began to stagnate and then decline.

Anti-tax movements also had emerged during this period, first rallying popular sentiment against high property taxes and then expanding the challenge to government spending more broadly. This made it politically difficult to raise the gas tax to cover the costs of construction and maintenance. At the local level, developers were increasingly asked to pay for off-site street and highway improvements that their developments necessitated. Local governments also began to turn to voter-approved taxes to pay for transportation projects (Adams et al., 2001, Goldman and Wachs, 2003).

Tightening revenues meant that there was less money for highway expansion, and in any case, such expansion was controversial in many areas as urban leaders and air quality and energy conservation advocates questioned the benefits of continued road building. Recognizing that interstate highway building was coming to a close, highway officials struggled to find a new highway program that would capture public support, while regional agencies leaders advocated for more money and authority to implement their programs.

In 1990, the Clean Air Act was again amended to extend deadlines for attainment of national air quality standards. Its provisions included tighter fuel and motor vehicle regulations and more requirements, including transportation control measures, for areas that had continuing air pollution problems. Because many metropolitan areas had not attained the national ambient air quality standards, transportation and air quality planning remained linked.

A year later, in 1991, ISTEA was enacted. ISTEA was a major change in direction for transportation programs but a manifestation of the changes in values that had already occurred in much of the country. The focus of transportation planning efforts had gradually moved from building transportation for basic economic development purposes to increasing its speed and efficiency, offering users a wider range of mobility options, and connecting transportation more explicitly to broader goals of prosperity, environment, and community. ISTEA recognized this shift by combining highways and transit in one legislative package, giving the highway builders some of what they were seeking by establishing that "high-priority corridors" be part of the National Highway System, increasing the flexibility of spending, and expanding funding for nonmotorized modes. ISTEA also granted MPOs more explicit authority over programming as well as funding to address continuing congestion and air quality problems. In addition, ISTEA called for the identification of high-speed rail corridors, although it did not provide funding for them.

Equity concerns also were reawakened. The ADA passed in 1992. Although the passage of Section 504 of the 1973 Rehabilitation Act had banned discrimination on the basis of disability by recipients of federal funds, disability advocates had spent the next two decades fighting for its implementation and to legislate remedies after court cases limited its application. In 1994, President William Clinton issued Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. While Civil Rights Acts had previously banned discrimination in federal programs, this executive order recognized that many outcomes were still unjust and required federal agencies to identify and address the disproportionately high and adverse human health and environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law, and to provide minority and low-income communities access to public information and public participation.

There was resistance at some state DOTs to the larger roles given to MPOs and to calls for environmental protection, sustainable development, and equity, which opponents characterized as requirements that went beyond the mission of the transportation agencies. Nevertheless, in many DOTs, changes in agency culture began to appear in the 1990s and early 2000s. In part, these changes were the result of staff turnover: Staff hired to design and build new facilities retired, and incoming staff were increasingly trained in environmental analysis as well as engineering, and in planning and policy as well as project delivery. New transportation technologies using sensors and software to manage highway operations sparked interest in alternatives to traditional highway expansion projects, as did demonstration projects testing the efficacy of road and parking pricing. When the US made its first halting steps in the closing years of the 20th century to make combatting climate change a priority, some state DOTs were ready for the challenge. Others, however, were dubious or even openly resistant, and as federal policy on climate change fluctuated and federal transportation policy waivered, many state DOTs stepped back.

Shifting priorities in transportation have reflected the issues and context of the times, and transportation institutions have been shaped in large part by these factors. Changes in practice were sometimes initiated as new technologies became available and as staff turnover occurred, and sometimes they came about through external forces—changes in legislation and public pressures. Over the years, the scope of transportation agencies' responsibilities broadened and the criteria for success became more complex, but changes that appeared to be outside the traditional mission of the transportation agencies were sometimes resisted.

Views of Government and Politics

Another factor shaping institutional organization and behavior was the changing views of government and politics. The preference for government intervention versus reliance on the private sector has been a recurrent theme. Both canals and rail lines were incentivized by government bonds and land grants but were privately owned and operated. Air transportation benefitted in the early days from government contracts for mail carriage, publicly constructed airports, and military investment in aircraft research and development that also was put to civilian use. Today, many transportation services combine public investments in facilities with private investments in vehicles and share responsibilities for operations; the state provides the highways, but private operators own the cars and trucks that travel on them. Still, debates over public-private partnerships continue and can be heated. One effect has been a hesitation at many DOTs to engage with the private sector in ways that could rekindle the debate.

Views of the role of politics in transportation also have fluctuated over the years. As an example, political involvement in public works decisions, such as project selection, has been viewed at times as corrupt, raising the specter that public funds and organizational positions will be used as political spoils going to pet projects and to friends and supporters, instead of being awarded on merit, with excessive costs and poor performance the result. Highway commissions were established in the Progressive Era between about 1870 and 1940 to take such politics out of highway decisions. The commissions were asked to carry out independent "needs" studies, offer knowledgeable expert advice, establish fair project selection procedures, select only worthy projects, and otherwise provide for businesslike governance and oversight to protect the public interest (cf. Hofstadter, 1955). Yet at other times, elected officials have been seen as the appropriate decision-makers and keepers of the public interest, accountable to voters should their decisions be unacceptable. From this perspective, commissions were the problem, with appointments seen as nothing more than political plums for supporters, friends, and special interests, producing unresponsive and opaque decisions for which no one could be held accountable. Views of highway commissions have waxed and waned over the years, and their assignments of responsibility have varied as well, with many becoming transportation commissions at about the same time that highway departments became DOTs. Today, these commissions are seen by some as protectors of decision

rationality and the public interest, defending against overreach by faceless bureaucracies. In other cases, commissions have been eliminated as unnecessary, potentially problematic relics of an earlier age, or their responsibilities have been greatly narrowed.

Likewise, views of government regulation have fluctuated, with regulation seen at times as protecting the public interest, and at other times, as reducing the general welfare. While transportation regulations of various sorts go back literally thousands of years—the Romans regulated night travel by chariot due to the noise it created—modern economic regulation was introduced in the late 1800s in the rail industry and in the early 1900s for pipelines, in both cases to tamp down abuses of monopoly power. In the trucking industry, regulation was introduced in the 1930s to prevent cutthroat competition and unsafe vehicle maintenance and driving practices. A few years later, airline regulations were introduced to improve carrier profitability and support the growth of the industry. Regulation spread to other common carriers operating interstate, and individual states also had regulations on many of the industries. By the 1960s, however, federal economic regulations were seen as stifling innovation and destroying profitability, and federal deregulation ensued in most transportation industries, although many state and local regulations were unchanged. The negative lessons from the regulatory period appear to have had lasting effect not only on the industries (where deregulation led to more competition, lower prices, bankruptcies, consolidations, and concerns about cartels), but also on decision-makers and public agencies, for whom the topic raises considerable unease.

The broad changes in policies and organizational responsibilities described here have varied in their impact across states and metropolitan areas. In California, where the state has decentralized many transportation decisions and has tougher rules on emissions and energy conservation than the national standards, federal policies granting MPO authority and more flexibility in funding have been congruent with state policy. Still, additional institutional changes might be needed to accomplish the state's ambitious goals for the transportation system.

5. The California Case

One question that arises is, how different is California from the broader history of technology and institutions presented in this paper?

Early History

California's transportation history reads much like that of the United States as a whole, although most of the state's growth occurred during the rail and highway motor vehicle eras (Wachs and Crawford, 1991; Brown, 2000). Roads were built by the Spanish and other earlier settlers, but most were unpaved and difficult to traverse. Los Angeles and the San Francisco Bay Area expanded along urban and suburban rail lines in the first years of the 20th century, but their systems ran into financial trouble and required public funding as auto use boomed. Both the cities and the State of California soon began building new arterials, bridges, and highways to accommodate growing traffic; for example, Los Angeles developed an extensive network of "boulevards," many of which started as trolley lines. Highway building was an expensive proposition, and by the 1920s, direct appropriations for highways and interest payments on general obligation bonds issued to pay for highway construction had risen to more than 40 percent of the state's budget. In 1923, the state adopted a gas tax and other road user fees to provide an alternative means of highway finance (Hill, Taylor, and Wachs, 1999). This, too, mirrored practices in many other states.

Developer provision or financing of local streets and adjoining arterials was introduced early in California and soon became common practice, with property taxes and other local fees contributing to street construction and maintenance. Gas taxes and other user fees funded the larger roads and highways. Tolls, on the other hand, were little used in California after the toll roads in the 1800s yielded mixed results. In the 20th century, California funded only bridges with tolls until the 1990s, when the first contemporary toll lanes were introduced (Deakin, 1990). This is different from the experience of the states in New England, the Middle Atlantic, and parts of the Midwest and South (including Florida and Texas), where toll roads were a familiar element of the highway system.

Freeway Boom and Bust

California was an especially enthusiastic participant in the freeway building of the 1950s and '60s. The Interstate Highway Act fell short of the state's ambitions: In 1959, the state adopted its own 12,241 mile freeway plan—nearly one-third the length of the entire interstate system. Plans called for both urban and rural freeways; in the cities, a grid of superhighways spaced about four miles apart was proposed (CA Div. Highways, 1958). Gas taxes and user fees were put in place to pay for this massive investment, and in the fast-growing state, revenues poured in, allowing pay-as-you-go financing (Jones, 1989).

As in other parts of the country, some of the freeways sparked revolts and sent the projects back to the drawing boards. Civil rights cases were filed against some of the highways slated to cut through communities of color in the Bay Area and the Los Angeles region. As environmental issues gained traction, the California Environmental Quality Act was passed, which not only required documentation of impacts but also called for their mitigation. Policies to alleviate the burdens of right-of-way takings were developed in California and became models for federal programs (MIT Oral History Project, 1974).

Pressed on environmental issues and social concerns, the state highway department was one of the first to add specialized staff in a Community and Environmental Factors Unit (MIT Oral History Project, 1974). California also was among the first to open up its highway trust fund to transit expenditures—through a citizen initiative—and in 1971, dedicated a quarter-cent sales tax to public transportation. Sacramento was one of the first metropolitan areas to turn back interstate highway dollars in exchange for funds for transit (Jones, 1989). Nevertheless, many transportation professionals at the time were disbelieving, thinking that the public would rise up in opposition to the environmentalists once they saw that highways were being stopped (MIT Oral History Project, 1974).

Costs of freeway building began to escalate in the mid-1960s (California Division of Highways, 1970). The causes were complex and not unique to California, although they hit California somewhat harder than average. Easy and (relatively) inexpensive roads had been built first; those remaining to be built were more complex and costly. Construction materials and labor costs were increasing, and requirements for environmental reviews and public involvement meant that projects took longer and cost more. Freeway development costs increased at an average of 8.2 percent per year in the '60s, or 3.5 times the average annual inflation rate. In the '70s, with far higher fuel costs and inflation rates of 8.7 percent, project costs rose even faster, averaging 12.1 percent per year (Taylor, 1993). Although revenues continued to grow, they did not keep up with the triple whammy of inflation, VMT growth, and decreasing fuel use per mile driven (thanks to new car standards). The inflation-adjusted gas tax collected per VMT was 3.8 cents a mile in 1955 and 4.5 cents a mile in the mid-1960s, but declined to 2.6 cents a mile in 1975 and 1.6 cents a mile in 1985 (Hill, Taylor, and Wachs, 1999). California's highway program, largely funded by the flat per-gallon gas tax, was running short on cash. With complaints mounting about "infrastructure in ruins" (Choate and Walter, 1983), in the early '80s, the Legislature directed that priority be given to maintenance and rehabilitation rather than new construction.

Transit in California

While many cities in California had trolleys and other transit systems in the late 1800s and early decades of the 1900s, as happened elsewhere, transit lost market share to automobiles as mass production brought costs down and transit systems began to stumble. By the 1950s, many transit services had disappeared. The California Legislature authorized the formation of a number of public transit districts, many of which took over financially struggling private bus companies to keep services running.

Seeking a more modally balanced transportation system, new urban rail systems were developed with substantial local funding, beginning with the Bay Area Rapid Transit (BART). BART planning was undertaken in the 1950s by a commission whose goals were to relieve congestion, protect the environment, and improve the quality of life in the region. The initial lines were designed and built in the 1960s, and BART opened its doors in 1972, using new technologies in train control and ticketing. While its short-term impacts were mixed (Webber, 1976), by 2019 its average weekday ridership was over 400,000 a day. The San Diego trolley began operations in 1981, and Sacramento's light-rail service commenced in 1987. Santa Clara County, which had chosen to build an expressway system rather than join the BART district, established a transit district of its own in 1972 and took over and consolidated failing bus operations. Los Angeles began the development of its modern-day urban rail transit system a few years later and greatly accelerated its construction in the 1990s (Deakin, 2015).

State funding for transit was authorized during this period by SB 325, Mills-Alquist-Deddeh Act (1971), commonly known as the Transit Development Act (TDA). TDA allocated a quarter-cent of the state sales tax to a Local Transportation Fund (LTF) and returned the funds to counties proportional to the sales tax generated there. TDA also imposed a sales tax on gasoline, proceeds from which were placed in a State Transit Assistance (STA) fund and provided to Regional Transportation Planning Agencies (RTPA) by formula. Under TDA, the RTPAs were required to create committees composed of local low-income, elderly, and disabled residents to advise on local needs.

Although transit was being expanded and state funding was flowing to it, the investment was a fraction of that being made in highways, which carried the preponderance of personal travel as well as freight. In addition, much of the responsibility for transit finance was left to local sources.

Financial Woes and Local Option Sales Taxes

Through most of this period, the state's political leadership showed little interest in increasing state taxes to keep highway expansion programs going. Indeed, California led the way not in new taxation but in tax slashing, starting with Proposition 13 in 1978. The voter initiative cut property taxes and restricted their growth, throwing local government finance into disarray and putting new pressures on state government to help out. Prop. 13 was followed by Proposition 4, which further restricted government's ability to raise taxes. Several California counties responded with sales tax measures earmarked for transportation (and other uses), starting a trend toward local self-help (Crabbe et al., 2005). With local option sales taxes, voters can choose to tax themselves for specific programs and projects at a specified rate for a specified period. Local option sales taxes implemented at the county level (and later, in some regions) became a major funding source for California transportation projects.

From the 1970s through the '90s, concerns about mounting costs and delays in project completion were exacerbated by public aggravation over congestion. Caltrans, the state highway department, was repeatedly called on the carpet by the Legislature and castigated in the press for its seeming inability to deliver solutions to these problems and for cost overruns on projects (CA Dept. of Highways, 1970). Transit agencies were not exempt from criticism about costs and accomplishments and, as was occurring at the federal level, the state applied performance measures in an attempt to keep costs under control and improve service delivery. In some cases, agencies failed to meet the performance measures, and modifications or exemptions were crafted to allow funds to continue to flow to them.

In 1990, California voters agreed to double the state gas tax, but the tax increase did not bring purchasing power anywhere near its former levels (Taylor, 1993). Much of the increased funding was needed just to rehabilitate and maintain the state's aging streets and highways, and the State Highway Operation and Protection Program (SHOPP) was established as a dedicated fund for safety, rehabilitation, and maintenance projects that do not add a new traffic lane (SB 1435, 1992). Funds also went to transit investments and construction of a few "missing links" in the freeway system. Other new highway projects were funded through the State Transportation Improvement Program (STIP). California did raise the gas tax again in 2017 (SB 1), but while the increase was substantial and revenues doubled, they were not enough to make up for the previous decades of cost inflation. In 2014, the Legislature asserted the need for greater oversight of the SHOPP in SB 486 (DeSaulnier, 2014), requiring Caltrans to develop a Transportation Asset Management Plan (TAMP) to inform SHOPP project selection, provide project budget and timing information in the SHOPP, and report quarterly on expenditures. SB 486 also required the California Transportation Commission (CTC) to set performance measures for the TAMP and approve the SHOPP only if it is consistent with the TAMP. SB 1's creation of an independent auditor for the new gas tax expenditures further underscored the Legislature's concern for assuring that funds are being spent effectively.

Changing Assignments of Responsibility

By 1997, the Legislature chose to devolve much of the responsibility for transportation to local agencies, giving the MPOs and county-level transportation agencies key responsibilities for transit coordination, highway and transit project selection, and impact management. In SB 45 (1997), the legislature changed the programming process, dividing the STIP into a Regional Transportation Improvement Plan (RTIP), where each RTIP combines the program of projects prepared by the regional agencies with those prepared by county transportation commissions, and an Interregional Transportation Plan (ITIP), a five-year program of projects focused on interregional connectivity and prepared by Caltrans. STIP funds were to be allocated 75 percent for RTIP projects and 25 percent for ITIP projects, and the CTC was directed to adopt all RTIP projects into the STIP or reject the RTIP entirely, lessening the CTC's control over project selection. Additional language in SB 45 mandated a 10-year state highway and bridges maintenance and rehabilitation plan and periodic reports on what had been achieved.

While on first glance it would seem that the programming changes would have empowered MPOs, SB 45 had mixed effects. It emphasized project delivery and aimed to accomplish this by clarifying and simplifying responsibilities, but it also gave counties an explicit voice in programming, adding another layer of authority. MPOs' roles had been boosted when ISTEA passed in 1991, and SB 45's all-or-nothing restriction on CTC changes to MPO programming ended the contentious practice of the commission deleting projects that the MPO had painstakingly negotiated or threatening to do so unless the MPO added projects that commissioners supported. However, as more and more counties adopted local option sales tax measures, they used their funding leverage and voter approval to push for MPO and state funds to be used as a county match. Studies of expenditures over the ensuing years found that significant shares of both state and MPO funds were used to complete projects and run programs that the counties had partially funded (Afonso, 2015).

Thus, to a large extent, the planning and programming process in California is heavily dependent on what the counties want. (Also note that many California MPOs encompass only one county, even when their commute sheds are multi-county.)

Renewed Emphasis on Environment and Equity

From the perspective of California state law, the early years of the 21st century might well be considered a second environmental era, this one focused on the looming risks of climate change. In 2006, AB 32 (Nunez), the California Global Warming Solutions Act, set in motion planning to reduce GHG emissions in the state, with targets aligned with those of the Kyoto Protocol. Among other objectives, AB 32 directed the California Air Resources Board (CARB) to develop plans and regulations aimed at returning GHG emissions to 1990 levels by 2020. SB 375 (Steinberg), enacted in 2008, required MPOs to develop Sustainable Communities Strategies (SCS) that linked land use—especially housing—to transportation and environmental quality. Ten years later, SB 32 (Pavley) extended and increased the requirements for GHG cuts, calling for a reduction to 40 percent below 1990 levels by 2030. SB 743 (Steinberg, 2013) produced changes in the environmental review of new development projects' transportation impacts, including moving away from "level of service" and delay to focus on VMT generation as a measure of concern in environmental reviews.

In addition, the early 21st century has been a period of increased focus on social equity issues in California. As in other states, California transportation agencies responded to federal civil rights laws (including the ADA) and executive orders on environmental justice. California had provided leadership in this area in the 1960s and '70s; for example, California pioneered relocation assistance that provided for equivalent ("replacement") housing, recognizing that housing in disadvantaged communities often had depressed market values, and fair market value payments for such housing would not necessarily allow a family to find a similar house. In addition, in the early 1970s, Berkeley became the first city to provide curb cuts; AC Transit was one of the first bus companies to provide wheelchair lifts. However, other actions by transportation agencies had disrupted low-income and minority communities, and investments in transportation needed by such communities had lagged. Over the past two decades, a series of laws have been enacted in California that give priority to improving conditions in disadvantaged communities. Finding that disadvantaged communities were especially at risk from climate change, SB 32 mandated that the manner of reducing greenhouse gases should benefit those communities. SB 535 (de Leon, 2012) directed that 25 percent of the proceeds from California's Greenhouse Gas Reduction Fund go to projects that provide a benefit to disadvantaged communities. AB 1550 (Gomez, 2016) further required that the 25 percent be spent on projects located in those communities. In addition, a number of programs targeting environment and equity issues have been established, including the Affordable Housing and Sustainable Communities Program, the Low-Carbon Transit Operations Program, the Transformative Climate Communities Program, the Sustainable Transportation Planning Grant Program, and the Transit and Intercity Rail Capital Program. However, the funding for these programs is limited, and the processes for receiving funds, each one a little different from the next, have been a barrier for some groups.

The 2020 murders of George Floyd and Ahmaud Arbery and the killing of Breonna Taylor led to massive public protests and commitments on the part of public agencies, including transportation agencies, to make bigger strides toward social justice going forward. In California, transportation agency actions to date include the creation of committees to advise on the needs of disadvantaged communities and acknowledgment in state and regional plans of the harms caused by past actions and the need for proactive efforts to improve the equity of transportation decision-making.

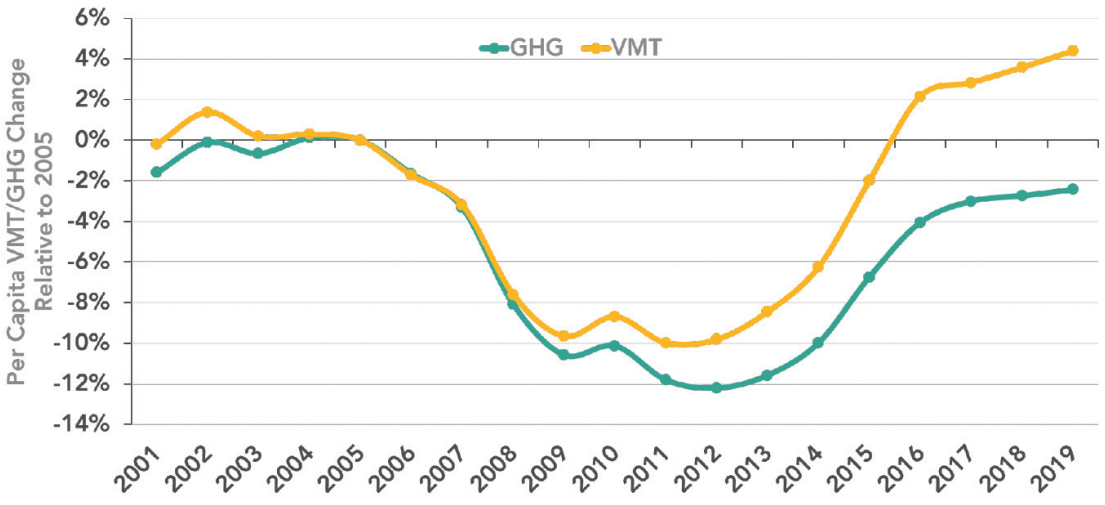
While legislation has been pathbreaking, performance has been less so. California has the worst air quality in the nation, and the US Environmental Protection Agency (EPA) lists 40 of California's 58 counties as nonattainment for one or more

of the national ambient air quality standards, with a number of the counties' air quality problems classified as serious, severe, or extreme (US EPA, 2021). Estimates of annual premature deaths due to transportation-related air quality violations in the state are in the thousands—a health and safety problem that is bigger than that caused by crashes on the state's streets and highways. According to the CARB's website, 7,200 premature deaths could be avoided if PM2.5 were reduced to background levels, along with 1,900 hospitalizations and 5,200 emergency room visits; if diesel particulate matter were removed from the air, the estimated yearly health impacts would be a reduction of 1,400 premature deaths. These numbers are in comparison to 3,798 traffic-related deaths in the state in 2018 and 3,606 in 2019 (CA OTS, 2021).

Improved vehicle and fuel technologies remain the key strategy for reducing transportation emissions, and California has been a leader in promoting clean fuels and zero-emissions vehicles. But because cars remain on the road for many years, and truck turnover takes even longer, it will be decades before the vehicle fleet produces zero emissions. Air quality violations continue, and additional strategies are needed to meet health standards.

Additional strategies are also needed to reduce GHG from transportation. Transportation is the largest source of GHG emissions in California, and while clean fuels and low- and zero-emissions vehicles are necessary to reduce GHG emissions, fleet turnover is not fast enough to meet pressing deadlines. The CARB's Scoping Plan identifies reductions in VMT as necessary to achieve the state's 2030 emissions target as well as the further reductions called for in executive orders, and Caltrans' analysis of currently adopted state and regional plans indicates that more actions are needed (Caltrans, 2021). But (pre-pandemic) VMT is growing and with it, GHG emissions (Figure 2). This puts added importance on additional measures to reduce GHG emissions if the mandate for emissions reductions is to be met.

Figure 2. California GHG and VMT changes over time



Source: CARB

The measures called for in MPOs' SCSs developed under SB 375—transit, ridesharing, pricing strategies, nonmotorized transportation—would achieve additional GHG reductions while also attaining important co-benefits, such as less congestion, improved public health through less exposure to transportation emissions, greater use of active transportation, social justice, more access to opportunities, and less damage to the natural environment. However, they have to be implemented, not just planned, to have an effect. Many of the same measures are included in federal law as potential air pollution reduction measures and have been mandated or encouraged as air pollution reduction strategies since the Clean Air Act Amendments of 1970, but their implementation has been spotty at best. A combination of insufficient funding for desired actions (for example, transit system expansion and enhanced operations, bike and pedestrian facilities) and mixed support for other measures, such as HOV lanes, trip reduction programs, and "indirect source" controls on new land development, has been a barrier to effective pollution control.

Just as the consequences of continued air quality violations fall most heavily on disadvantaged communities, the consequences of global warming will disproportionately affect the disadvantaged. Global warming can result in extreme weather events, droughts, increased fire hazards, sea-level rise, increased air pollution, increased exposure to pests and diseases, and ecosystem pressures. Because of the long lag times between emissions and consequences, some global warming is inevitable and will require action to reduce harms. Keeping global warming to the levels recommended by the scientific community will not only help to reduce these adverse effects but will also buy time to develop additional technologies to deal with the consequences.

Air pollution and global warming are not the state's only challenges. With the state's high concentration of important farmlands, its complex and unique landforms and natural features, and its natural hazards of fire, flood, and earthquake, much more is at stake. Transportation facilities are among the most prevalent barriers to wildlife, and with many endangered and threatened species, habitat conservation is an issue throughout much of the state. Water supply and quality is a problem, and transportation facilities have been identified as a major source of water pollution. Housing affordability is among the lowest in the nation, and supply is not keeping up with demand; for some, this means crowding and substandard living conditions while for others it means increasingly long commutes. Traffic from the state's large ports travels through communities of color, leading to disproportionate harm from particulate exposure and noise. Congestion slows many trips, increasing costs and making travel stressful. A sparse road network in parts of the state means transportation can be difficult for both passengers and freight haulers. Development densities are increasing somewhat, but in most areas are still well below the levels needed for cost-effective transit.

Transportation control measures listed in the Clean Air Act Amendments of 1990

"(i) programs for improved public transit;
"(ii) restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high occupancy vehicles;
"(iii) employer-based transportation management plans, including incentives;
"(iv) trip-reduction ordinances;
"(v) traffic flow improvement programs that achieve emission reductions
"(vi) fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service;
"(vii) programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;
"(viii) programs for the provision of all forms of high occupancy, shared-ride services;

"(ix) programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of nonmotorized vehicles or pedestrian use, both as to time and place;
"(x) programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;
"(xi) programs to control extended idling of vehicles;
"(xii) programs to reduce motor vehicle emissions, consistent with title II, which are caused by extreme cold start conditions;
"(xiii) employer-sponsored programs to permit flexible work schedules;
"(xiv) programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;
"(xv) programs for new construction and major reconstructions of paths, tracks or areas solely for the use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest. For purposes of this clause, the Administrator shall also consult with the Secretary of the Interior; and
"(xvi) program to encourage the voluntary removal from use and the marketplace of pre-1980 model year light duty vehicles and pre-1980 model light duty trucks."

Source: Clean Air Act Amendments of 1990, Section 108, 42 USC 7408

SB 1: A Funding Reset

An important increase in transportation funding for California was made possible through SB 1 (Beall, 2017), the Road Repair and Accountability Act. The legislation raised the state gas taxes and other fees for transportation and is estimated to make over $50 billion available to the state and localities over a 10-year period to fix roads, freeways, and bridges and make additional investments in transit, intercity rail, active transportation, and the freight network. SB 1 emphasizes "fix it first," maintaining the state's investments in a state of good repair, for which it allocates about 60 percent of the total estimated revenues. The legislation also establishes performance measures and independent audits to assure that funds are being spent efficiently and in accordance with policy.

SB 1 includes a program for congestion relief, but unlike earlier federal and state legislation that emphasized highway expansions as the means for relieving congestion, SB 1 spells out an approach that emphasizes "benefits to mobility, quality of life, and the environment through comprehensive, multimodal proposals that address mobility, community, and environmental challenges along highly traveled corridors." Under its Solutions for Congested Corridors Program, elements can include streets and highways, transit, bike and pedestrian facilities, and habitat and open space preservation. Program evaluation criteria include safety, congestion, accessibility, economic development and job creation and retention, furtherance of state and federal ambient air standards and GHG emissions reduction standards pursuant to AB 32 and SB 375, efficient land use, matching funds, and project deliverability. In addition, priority is given to projects that are cooperatively developed with state and local participation; projects must be included in regional plans with approved SCSs to be eligible for this funding. While SB 1 only partially covers expected "needs"—the legislation reported a $59 billion shortfall to adequately maintain the existing state highway system, plus a $78 billion shortfall for city and county roads—together with anticipated federal funds from the 2021 infrastructure bill, it creates new opportunities for an integrated multimodal transportation system that better serves the state's environmental, equity, and economic development goals.

According to the state's 2021 5-Year Infrastructure Plan, California proposes to spend over $44.5 billion on transportation infrastructure over the next five years. This includes almost $4 billion for high-speed rail and related projects. The biggest allocation, nearly $24 billion, is for highway repair and rehabilitation projects planned in the SHOPP, and the second highest amount, over $12.5 billion, is for local transportation funding. Another $3.1 billion is for STIP projects, with 75 percent going to regional SCSs and 25 percent to interregional projects. The plan also anticipates that $1.3 billion will go to congested corridors, and $1 billion for partnerships with local transportation agencies. While transportation taxes are expected to be $1.5 billion less than originally forecasted due to the COVID-19 pandemic, federal relief funds and (presumably) new federal infrastructure funds are anticipated to cover the gap.

The infusion of funds from SB 1 has allowed California to reduce its maintenance backlog, and the new, substantially increased federal infrastructure funding should allow repairs to be accelerated. However, more action is clearly needed with respect to the state's continued violations of air quality standards and its GHG reduction targets.

The Multi-Goal Implementation Problem

Implementation has long been recognized as a public policy problem (Pressman and Wildavsky, 1976), and it is an issue for California transportation policy. State and regional plans are inspirational, but they include measures for which there is no authority, no funding, or both. SCS measures are especially vulnerable because of the institutional complexities of accommodating change, as discussed earlier, and because of pockets of opposition to specific measures in the SCSs, such as increased densities and transportation price increases. A number of the land use and transportation actions that MPOs have included in their SCSs require local government action, but SB 375 does not require local governments to implement the measures. Housing elements are required to show sufficient parcels zoned for housing to meet projected needs, but this has not been sufficient to overcome production shortfalls, and an increasing number of Californians commute long distances to find housing that they can afford. In short, devolution of responsibility to local government has made it hard to exert state or regional control over outcomes.

Full implementation of some actions that are usually popular with voters—transit improvements, bicycle lanes, parking, and sidewalk improvements—would require greater funding than is currently available (Deakin, 2019). Several proposed measures in SCSs also pose a conundrum: For instance, increased transit service is a big part of many SCSs, and successful transit would certainly reduce auto use and its impacts, but pre-pandemic transit ridership was declining in many parts of the state, and the pandemic has further reduced the use of shared modes of travel. Furthermore, funding for bringing transit up to service levels that would compete with the automobile in terms of door- to-door travel time and out-of-pocket cost has not even been calculated.

MPOs have had some success in incentivizing implementation by tying funds that they control to action on the SCS elements, but most report a need for substantially more funding to do this effectively. At the state level, the California State Transportation Agency (CalSTA) has moved to reduce GGH emissions through its Climate Action Plan for Transportation Infrastructure (CAPTI). Under CAPTI, the state will invest transportation dollars over which it has discretion to aggressively combat and adapt to climate change while supporting public health, safety, and equity. The question remains whether these regional and state actions will be enough to change the results on the ground. If not, other strategies for cutting emissions might need to be accelerated.

New capacity continues to be added to the state highway system. Over the long term, the added lane miles will increase maintenance obligations, and in the medium to long term, VMT might increase. For a number of the planned capacity increases, the effects on VMT due to induced travel have not been fully accounted for using best practice methods

(Volker, Lee and Handy, 2020). As a result, such VMT has not been fully mitigated as part of the project and will make it more difficult to achieve state goals for GHG and other emission reductions. The added capacity in some cases might also create environmental justice problems, further dividing communities and exposing populations to pollution.

Implementation processes for large capital projects often take a decade or more from their initial proposal through planning and design to reach readiness for construction. Project sponsors and other supporters become committed to seeing their projects through to fruition. Unless explicitly directed otherwise, many transportation agencies continue to pursue implementation of projects proposed years earlier, viewing them as obligations; sometimes they are indeed obligations, for which repayment of funds might be required if the project is not completed. Meanwhile, resources are limited, and new proposals are surfacing. Because the costs of new capacity are not always fully covered by the projects—for example, long-term maintenance costs are not usually included in project costs, and community and environmental costs might not be fully mitigated—some transportation officials question whether the projects should advance. Others see these projects as posing tradeoffs; in particular, they question whether GHG and social equity should be given higher priority than, for example congestion relief, economic development, highway user safety, capturing federal funding, or other goals that also have been enunciated in federal and state legislation.

It is clear that over the past 50 years the US has added goals and objectives to transportation plans without, in most cases, retracting others. Many of these goals aim to ensure that funds are spent wisely (asset management, fix it first), that benefits of projects (mobility and access, economic development) are in fact captured, and that negative externalities are avoided or mitigated (deaths and injuries, environmental pollution, community disruption). The challenge is how to achieve multiple objectives. Accounting for the full benefits and costs of projects is considered a best practice internationally, but the calculus is not a simple one, and many uncertainties must be acknowledged.

Today, climate change has reached the point where without aggressive intervention in the next two decades, severe and persistent damage will be unavoidable. Greenhouse gases emitted today will persist in the air for years: over a dozen years for methane, decades on average for carbon dioxide, and far longer for other GHGs. If GHG emissions are slowed, temperatures will continue to rise for some time. However, without concerted action in the next couple of decades, it is unlikely that temperature increases can be kept below 2.7° Fahrenheit (1.5° Celsius)—the level that experts advise is feasible and will produce manageable negative impacts. Above that threshold, harm could be catastrophic. For this reason, experts in the field argue that explicitly prioritizing investments that reduce emissions is a necessity now.

In addition, the disparate impacts of past and current practices on people of color, people with disabilities, the elderly, and women are finally being recognized. Many are demanding change, that it is not just a matter of avoiding harms in the future but also of redressing longstanding inequities. These issues are recognized in contemporary policy, but the promises for change are not yet fulfilled. Keeping these promises would require change. Designing projects that achieve the multiplicity of goals could be a way forward. Alternatively, projects could be combined with others that would offset (mitigate) their impacts in a timely fashion, leading to overall progress on the full set of goals. Alternative approaches could offer positive ways forward, for example, using operations strategies, new technologies, or pricing to reduce traffic congestion or offering competitive levels of service in transit or new mobility to allow congestion to be avoided. Finding a balance between keeping past promises and advancing urban objectives might be complex but could also be the only way to successfully address today's pressing equity and environmental problems in a timely fashion.

Some of the stakeholders interviewed for this project questioned whether priorities have in fact changed. However, the state has established legislative priorities for infrastructure planning, as stated in AB 857 (Wiggins, 2002) (Govt. Code 65041.1):

"The state planning priorities, which are intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety in the state, including in urban, suburban, and rural communities, shall be as follows:

(a) To promote infill development and equity by rehabilitating, maintaining, and improving existing infrastructure that supports infill development and appropriate reuse and redevelopment of previously developed, underutilized land that is presently served by transit, streets, water, sewer, and other essential services, particularly in underserved areas, and to preserving cultural and historic resources.

(b) To protect environmental and agricultural resources by protecting, preserving, and enhancing the state's most valuable natural resources, including working landscapes such as farm, range, and forest lands, natural lands such as wetlands, watersheds, wildlife habitats, and other wildlands, recreation lands such as parks, trails, greenbelts, and other open space, and landscapes with locally unique features and areas identified by the state as deserving special protection.

(c) To encourage efficient development patterns by ensuring that any infrastructure associated with development that is not infill supports new development that uses land efficiently, is built adjacent to existing developed areas to the extent consistent with the priorities specified pursuant to subdivision (b), is in an area appropriately planned for growth, is served by adequate transportation and other essential utilities and services and minimizes ongoing costs to taxpayers."

Taken together with the mandates for greater spending on equity and for combatting climate change, the current policy framework for California does seem to call for moving in new directions and is consistent with policies being enunciated by the new federal infrastructure bill. Contemporary policies include but go beyond the earlier build, operate, maintain objectives that transportation agencies in California started with over a century ago. Effective implementation of the full set of policies and priorities requires skills not only in engineering but in planning and forecasting, economics, evaluation, public participation, and consensus building. Finding strategies and incentives that accomplish multiple goals offers a way forward, but it also might be necessary to rethink institutional arrangements, assignments of responsibility, staffing, and spending levels to meet the challenges.

Discussion

Economic development and the provision of fast, safe, and efficient transportation were the main policies driving transportation planning and investment in the US from the earliest years of colonial settlement. For many years, the priority was to build connected networks of facilities to provide access and support economic development. Highways and motor vehicles became the dominant transportation technology over 100 years ago, and with massive federal assistance, the states built primary roads and then an Interstate system of limited-access highways, transforming passenger and freight travel.

California was an especially enthusiastic investor in highways, building a large state-owned network in addition to the Interstates within its borders. Today, driving is the mode choice for nearly 90 percent of the trips in California, including many trips under a mile in length. Motor vehicles also deliver most of the freight in the state. VMT is increasing, a result of population and economic growth, but also as a result of the long-term concentration of government resources on automobility and the low-density development patterns automobility has enabled.

In the late 1960s and early '70s, with the Interstate program nearing completion, large-scale highway construction began to slow. By the 1980s, the highways built in the post–World War II era were wearing out, and highway programs began to shift to operations and maintenance. Over the same period, public funding for transit became standard, although funding

levels were modest; urban interests were given a greater voice in transportation choices, and concerns about community and environmental impacts objectives gained prominence. Civil rights laws, the National Environmental Policy Act, and the Clean Air Act introduced a wider range of considerations into transportation planning and decision-making.

The organizations and planning processes devised to deliver and manage transportation systems have generally reflected the problems, opportunities, and cultural beliefs of their day. When the mission was to design and build a network of facilities, engineering skills were central. Accordingly, the country's army engineering skills were tapped to build early canals and rail lines, and military organization and management models shaped both private transportation companies and public works organizations. Highway departments followed suit, emphasizing civil engineering skills and innovations. Over time, additional institutions were established to handle problems in governance and management. Regulatory agencies were formed to prevent private operator price gouging and other unfair practices. Commissions were formed to oversee public sector bureaucracies and infuse a business-like culture of cost management and efficiency into their transport projects. Ballot-box measures were introduced to allow the people to have a direct voice in government. MPOs were established to give urban areas greater say over the projects being built within their borders. Highway departments became transportation departments when federal government grants began to flow for transit and intercity modes, and political leaders clamored for a balanced transportation system. And lately, partnerships among transportation, housing, and environmental officials have been established to better coordinate development efforts—although some would argue that this is a throwback to the comprehensive planning and coordination policies of the 1960s.

The road systems first envisioned nearly a century ago are largely built out, and attention has increasingly turned to improving equity and the environment so that all can experience a high quality of life, maintaining and expanding prosperity and continuing to improve public health and safety. With a mature and extensive highway system in place, greater attention is being given to managing and operating the system and increasingly to using new technologies and methods to do so, including telecommunications, sensors, information technologies, automation and control systems, and pricing strategies. New mobility providers are offering services that blur distinctions between public and private, transit and auto. Other transport modes are still developing. New forms of personal transport include micromobility options, on-demand services, driverless vehicles, and smart highways. Making use of these new technologies is not just a matter of technical expertise but new kinds of expertise—not just civil engineering but electrical engineering and computer science; not just engineering skills but also planning and policy skills and experience in working with communities to incorporate their needs and preferences. Accommodating these new technologies and planning approaches requires an expanded skill set and might also require changes in institutional arrangements, organizational design, and assignments of responsibility. Transportation agencies continue to have important roles as designers and builders, but today substantial attention also must be given to planning, management, and operations.

California has followed much the same path as the rest of the United States, but the state has some notable features that make transportation policy and planning particularly complex. Over the past century, the state has experienced massive growth in its economy and population despite difficulties in keeping up with growth. With the state's high concentration of important farmlands, its complex and unique landforms and natural features, its many endangered and threatened species, and its natural hazards of fire, flood, and earthquake, maintaining a high quality of life in California has required forward-looking political leadership and careful stewardship. The state has responded to the challenge through policy leadership, especially with regard to ambient air pollution and climate change, although implementation has not always been smooth.

Nationwide and in California, transportation goals have expanded over the years from providing access, facilitating mobility, and supporting a vibrant economy to also include maintaining transportation facilities in good repair, providing safe and secure transportation, avoiding or mitigating environmental pollution, supporting healthy communities,

eliminating transportation burdens for disadvantaged groups, and fighting climate change and its effects. The climate change challenge is particularly acute because GHG emissions have reached the point where, without substantial intervention in the next two decades, severe damage will be unavoidable. The recognition of global warming as a crisis with deadlines has been slow in coming, and in the US, controversial, but California has provided leadership and has made combatting climate change a high priority.

In the past year, practices that have disproportionately harmed people of color and left out low-income individuals and households, people with disabilities, women, children, and the elderly have finally been acknowledged in California and across the US. Acceptance of the need for change is leading to new efforts to remediate problems and deliver equitable programs and services. The social equity challenge is acute because disparate impacts are leading to premature deaths and other harms among the most vulnerable, and delayed action to provide equal access and opportunity is leading to distrust and a lack of confidence in democratic government.

While California has taken many steps forward, it also faces stumbling blocks along the way. California's predilection for local control of land use and local sales tax financing of transportation, the divided responsibilities for programs at the state level, the difficult position of MPOs—their many responsibilities for planning but limited authority to implement their plans—and Caltrans' highly decentralized organization, where many decisions are devolved to district offices, together have created an institutional framework with substantial communication "noise" and inertia, both of which can make it very difficult to steer investments in a different direction. This institutional complexity has been identified as an issue that slows implementation of policy changes in at least two major reviews over the past 25 years (SRI, 1994; SSTI, 2014). Further, the institutional arrangements, assignments of responsibility, and processes devised to plan, design and deliver facilities might not be fully aligned to carry out the more holistic, multimodal, integrated transportation, land use, and environmental programs needed today.

Uncertainty about the future complicates finding a way forward. The COVID-19 pandemic has disrupted traditional ways of going to work, shopping, and socializing for many. Among the changes visible at this time are massive declines in air travel, sharp losses of transit riders, a five-fold increase in telecommuting, and a substantial increase in e-commerce. It remains to be seen whether, how long, and to what extent the forced changes that the pandemic imposed will last. At the same time, it appears that transportation is on the cusp of another period of pathbreaking technological innovation. The disruptions being created by technological change can open up opportunities to rethink institutional arrangements and planning processes. New funding from the federal government could also open up new possibilities.

6. Summary: Key Findings

Key findings from this review of the technological and institutional history of the US and California are as follows.

1) Economic development and the provision of fast, safe, and efficient transportation were the main policies driving transportation planning and investment in the United States from the earliest years of colonial settlement until quite recently. Although the technologies changed over the years, in each era, building a network of facilities was the highest priority. California followed much the same pattern.

2) After the invention of the automobile, considerable attention was given to developing a fast, safe, efficient highway network. The Interstate Highway program of the 1950s and '60s, funded mostly by the federal government, helped

transform passenger travel and freight movements throughout the country, and the auto-highway system became the dominant means of travel in most of the US. California grew rapidly as motor vehicles and highways gained dominance, and the state invested heavily in highways; large parts of California, urban as well as rural, developed around motor vehicle transport. Today, VMT is increasing, a result of population and economic growth but also due to low density land use patterns, lack of competitive travel options, longer commutes, and the growth in e-commerce.

3) By the 1980s, increasing numbers of highways were in need of repair and rehabilitation. The US, including California, had an extensive network of facilities that were suffering from deferred maintenance, and policy attention and funding began to be directed to this problem. With inflation reducing buying power and fuel-efficiency standards reducing revenues per mile driven, funds were increasingly tight, but gas tax increases were hard to come by. In California, local option sales taxes for transportation became a way to provide funds for transportation projects that voters would support. These taxes have funded numerous street and highway projects as well as transit capital and operating projects. However, the political commitments behind the tax expenditure plans have made it hard to reconsider their content or priorities.

4) State goals and priorities for transportation have broadened significantly over time, both nationally and in California. Goals have expanded from providing access, facilitating mobility, and supporting economic development to also include maintaining past investments in a state of good repair, assuring that transportation is safe and secure, securing a healthy environment, supporting community development and improving the quality of life, combatting climate change, and repairing and avoiding social inequities. This multidimensional set of objectives for transportation has added to the challenges that transportation agencies face.

5) California has been a leader in policies to protect the environment and to combat climate change, but its accomplishments have sometimes fallen short of its ambitions. There is a gap between goals and attainment in large part because of motor vehicle use. Air pollution remains a problem with nonattainment of ambient air quality standards across much of the state and, in some areas, at levels that are severe or even extreme. The cost to public health is significant, with early deaths attributable to air pollution each year exceeding the number who die in motor vehicle crashes.

   While the state has set ambitious policies for GHG reduction, as of 2019, it was not on target to meet its 2030 GHG goals, and increasing VMT is a large part of the problem. GHG reduction is an environmental hazard that cannot continue to be delayed if the risk of catastrophic levels of global warming are to be avoided. Nevertheless, both CARB and Caltrans have identified projects that are likely to increase VMT and greenhouse gases, making climate goals harder to reach.

6) The state has also created a complex institutional structure for transportation, decentralized across many agencies and levels of government. There is ambiguity about policy priorities, responsibilities for implementation, and authority to enforce policies. Local control is strong, and neither state agencies nor the regional planning agencies have been given authority to require action on many state and regional goals. For example, important policies like SB 375 apply to regions but not to counties or cities, and a large share of the funding for transportation comes from programs that have no explicit requirement to be coordinated with state policies.

7. Recommendations

The recommendations presented here are intended for further consideration. They are preliminary, and we recommend that they be discussed in greater detail with stakeholders.

Review and Align State Goals

State agencies have been directed to establish and maintain a high-quality, resilient, multimodal transportation system that provides mobility and accessibility for all users and to see that the transportation system is safe and secure, meets GHG emission reduction targets, eliminates burdens for disadvantaged groups, supports economic development, protects the environment, and enhances public health and vibrant communities. These goals are listed in the California Transportation Plan. They are established in legislation and executive orders and have been expressed in regulations and guidance documents, but the language varies and so does the emphasis given to different goals. Some goals are more specific than others, and some include specific performance deadlines. Some laws and programs list some of the goals but not others.

While there is general agreement that all the goals are relevant, there appears to be less agreement on how to handle situations where proposed actions advance one goal but are in apparent conflict with others. This has been identified, for example, when a project that improves mobility also increases emissions. One reading is that legislative and executive directives have prioritized tackling climate change and environmental justice issues, while others interpret the goals as not having any particular priority, or priorities as applying in limited ways (for example, applying to plans but not to specific projects, or applying to the agencies directed to implement particular policies, or applying only prospectively and not requiring changes in previous decisions). Some stakeholders interpret the law as prioritizing goals in proportion to budget levels.

Several strategies are available for clarifying policy and better aligning state goals. This could be done by the stakeholder agencies getting together and agreeing on priorities and conflict resolution processes, by the Governor issuing direction to the state agencies by means of an executive order, by a stakeholder process coordinated by an independent advisory committee, or by the Legislature clarifying intent through additional legislation or revisions to existing law. The outcome could take several directions: flagging some goals as higher priority than others, identification of goals that are to be achieved in the short run while others are to be aimed for over a longer time period, requiring that overall plans and programs meet all goals and performance targets in each planning or programming period even if particular projects do not do so (requiring compensatory action to make up for noncompliant projects), or identification of strategies for harmonizing the goals, for example, by focusing on measures that can achieve multiple goals without setting any back.

Review and Update the Roles of Transportation Organizations at the State, Regional, and Local Levels

California's complex, decentralized current institutional arrangements make it difficult to understand who is responsible for various actions, which in turn makes it hard to hold any particular agency responsible for goal achievement. A review of transportation institutions and the assignments of responsibility, authority, and resources available to them could lead to the identification of reforms that would produce improvements in transparency and performance. At the state level,

this review would involve examining and possibly revising CalSTA, Caltrans, and CTC roles and responsibilities for establishing the state transportation vision and for implementation actions, including the selection of projects to make that vision a reality. The review could also extend to other state agencies, including CARB, the Office of Planning and Research, and the Strategic Growth Council, that set policies and deliver projects and programs that affect transportation.

Because regional plans are major inputs to state plans, a review of this relationship, including the consistency of regional plans with state policy goals, would also be in order. The review could examine assignments of responsibility and criteria for planning and project selection and prioritization. The results of the review could include recommendations for changes to organizational responsibilities and authority to act and could also include recommendations on funding and staffing for the agencies to make sure that they are adequately equipped to carry out the assignments that they are being given so that they are able to deliver as expected.

At the regional level, MPO geographic scope, cross-border relations, board composition, voting rules, assignments of responsibility, and financial capacity could be reviewed, with the aim of assuring that the MPOs have the institutional structure, legal authority, political support, and resources that they need to effectively accomplish what is expected of them. This review would take into consideration the role of key inputs to regional plans and programs, including city and county land use and transportation plans and county transportation programs. A forum on the role of MPOs could involve exploring opportunities to provide MPOs with additional authority to make decisions about the transportation plans and programs within their jurisdictions, for example, to require local plan and program consistency with the SGSs as a condition of matching funds, or could identify ways to incentivize greater cooperation across the region and with state agencies on critical issues, such as freight corridors, interregional passenger connections, transit pricing and funding, housing and labor markets, and the resulting jobs-housing balance and affordability. The MPO discussion could also cover evaluation methods and performance measurement and reporting, matters that could improve both the agencies' own ability to assess outcomes and the ability of state agencies to put it all together into a statewide assessment of performance.

Reviews could also extend to local transportation planning and expenditure issues. Such reviews could include the role of city and county plans and expenditure programs and their performance with respect to state goals. Other topics for discussion could include local funding needs, for example, for active transportation, complete streets, and transit and paratransit operations, and could extend to such topics as economic development strategies for improving jobs-housing balance and reducing traffic problems. Local agencies and stakeholders are also likely to have recommendations on transportation-related social equity problems within their jurisdictions, and their identification of needed actions could help state agencies turn statements about the need for environmental justice into action plans.

Another issue that could be discussed is legacy projects. Implementation processes for large capital projects often take a decade, or even several decades, from their initial proposal through planning and design to reach readiness for construction. In many cases, these projects were first conceived before contemporary planning goals such as GHG reduction were identified and before new designs and technologies that offer alternative solutions were available. Finding a balance between keeping past promises and advancing current objectives might be complex but might also be the only way to successfully address today's pressing goals in a timely fashion while equitably addressing longstanding problems.

Acknowledgments

This paper draws upon earlier work by the author for the Pat Brown Institute, the California Transportation Association, and the Transportation Research Board as well as on her 2019 edited book. Discussions with 10 scholars and practitioners who are experts in transportation history and institutional issues provided valuable suggestions for topics to include in the necessarily abbreviated coverage of a broad topic. Comments received from Egon Terplan of the Strategic Growth Council have been helpful in refining and elaborating on key points, as were comments of academic reviewers and reviews solicited from stakeholders by the SGC.

Funding for this iteration of the work was provided by the California Strategic Growth Council. The views expressed herein are those of the author who is responsible for any errors or omissions.

References

Abernathy, W. J., and Utterback, J. M. (1978). Patterns of industrial innovation. Technology review, 80(7), 40-47.

Adams, M. et al., "Financing Transportation in California," UCB ITS RR 2001-2, March 2001.

Afonso, W. B. (2015). Leviathan or flypaper: Examining the fungibility of earmarked local sales taxes for transportation. Public Budgeting & Finance, 35(3), 1–23.

Aldrich, H. E., and Pfeffer, J. (1976). Environments of organizations. Annual review of sociology, 2(1), 79-105.

Anderson, M. (1964). The Federal bulldozer. A critical analysis of urban renewal, 1949-1962.

Anderson, P., and Tushman, M. L. (1990). Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly,* 604–633.

Avelino, F., and Rotmans, J. (2009). Power in transition: an interdisciplinary framework to study power in relation to structural change. European journal of social theory, 12(4), 543–569.

Blanco, H. (2021). Failing Malls: Optimizing Opportunities for Housing. University of Southern California: National Center for Sustainable Transportation.

Bridges, W. (1991). Managing transitions: making the most of change. Reading, MA: Wesley Publishing Company.

Brown, Jeffrey, Statewide Transportation Planning in California: Past Experience and Lessons for the Future. Institute of Transportation Studies, University of California, Los Angeles, 2000.

California Air Resources Board. 2018 Progress Report: California's Sustainable Communities and Climate Protection Act. Nov. 2018. http://www.arb.ca.gov/cc/sb375/sb375.htm

California Division of Highways, "The California Freeway System," Report to the Joint Interim Committee on Highway Problems, Sacramento, 1958.

California Division of Highways, "Spiraling Costs," A Report on the Causes and Effects of Increasing Highway Project Costs and on Recommended Courses of Action, Sacramento, 1970.

California Dept. of Transportation (Caltrans). California Transportation Plan 2050. Feb. 2021.

California Office of Traffic Safety (CA OTS). 2021.California Traffic Safety Quick Stats. https://www.ots.ca.gov/ots-and-traffic-safety/score-card

Calthorpe, P. (1993). The next American metropolis: Ecology, community, and the American dream. New York: Princeton Architectural Press.

Cervero, R. (1989). America's Suburban Centers: The Land Use-Transportation Link. Boston: Unwin-Hyman.

Cervero, R., and Kockelman, K. (1997). Travel Demand and the 3Ds: Density, Diversity, and Design. Transportation Research D, 2(3), 53-62.

Choate, P., and Walter, S. (1983). America in ruins: The decaying infrastructure. Duke Press Paperbacks.

Coetsee, L. (Summer, 1999). From resistance to commitment. Public Administration Quarterly, 204–222.

Crabbe, Amber E. et al., Local Transportation Sales Taxes: California's Experiment in Transportation Finance (Institute of Transportation Studies, University of California, Berkeley, 2005.

Deakin, Elizabeth, "Toll Roads: A New Direction for US Highways?" Built Environment, Vol. 15, No.3/4, 1989-90, pp. 185-194.

Deakin, Elizabeth (2002). "Transportation in California: The Coming Challenges," in California's Future in the Balance: Transportation, Housing/Land Use, Public Higher Education, and Water Four Decades Beyond the Pat Brown Era, A. Modarres and J. Lubenow, eds., The Edmund G. "Pat" Brown Institute of Public Affairs, California State University, Los Angeles.

Deakin, Elizabeth (2006). "The Social Impacts of the Interstate Highway System", in Celebrating the Interstate's 50th Anniversary, TR News 244, May–June 2006, pp 16–17. https://onlinepubs.trb.org/onlinepubs/trnews/trnews244social.pdf

Deakin, Elizabeth (2015). Transit at 50, California Transit Association, Sacramento.

Deakin, Elizabeth, ed. (2019). Transportation, Land Use, and Environmental Planning. Elsevier.

Deakin, Elizabeth, Arthur C. Nelson, Kristina Currans, David Lee, and John Renne (2021). "Transportation and Land Development." Centennial Papers Transportation Research Board. 2021.

de Jager, P. (2001, May/Jun). Resistance to change: a new view of an old problem. The Futurist, 24–27.

Dent, E., and Goldberg, S. (1999, March). Challenging "resistance to change." Journal of Applied Behavioral Science 25–41.

Duany, Andres, Plater-Zyberk, Elizabeth, and Speck, Jeff (2005). Suburban Nation. New York: North Point Press.

Dowling, J., and Pfeffer, J. (1975). Organizational legitimacy: Social values and organizational behavior. Pacific Sociological Review, 18(1), 122–136.

Federal Highway Administration (FHWA) (2021, Dec. 16). https://www.fhwa.dot.gov/bipartisan-infrastructure-law/building_a_better_america-policy_framework.cfm?source=email

Federal Transit Administration (FTA) (2021, Nov. 15). https://www.transit.dot.gov/about/news/us-department-transportation-announces-key-priorities-funding-public-transportation

Ferguson, E. (1990). Transportation demand management planning, development, and implementation. Journal of the American Planning Association, 56(4), 442–456.Fishman, Robert, Bourgeois Utopias: The Rise and Fall of Suburbia, New York: Basic Books, 1987.

Flyvbjerg, B., Holm, M. S., and Buhl, S. (2002). Underestimating costs in public works projects: Error or lie? Journal of the American Planning Association, 68(3), 279–295.

Friss, Evan (2015). The Cycling City. Chicago: The University of Chicago Press.

Furst, S.A. and Cable, D.M. (2008). Employee resistance to organizational change: managerial influence tactics and leader-member exchange. Journal of Applied Psychology, 93(2), p.453.

Garrison, W. L., and Deakin, E. (1992). "Land Use," in G. Gray and L. Hoel, Eds., Public Transportation (2nd ed.), Englewood Cliffs, NJ: Prentice Hall, 1992, pp. 527–550.

Giuliano, G. (2004). Land use impacts of transportation investments. In Hanson, S. and Giuliano, G. (eds.) The Geography of Urban Transportation, Ch. 3, 237–273.

Giuliano, G. (1995). The weakening transportation-land use connection. Access Magazine. Berkeley: UC Transportation Center, 1(6), 3–11.

Goetz, Charles J. (1977). "Fiscal Illusion in State and Local Finance." In T. E. Borcherding, ed. Budget and Bureaucrats: The Sources of Government Growth. Duke University Press.

Goldman, Todd, and Martin Wachs (2003). "A Quiet Revolution in Transportation Finance: The Rise of Local Option Transportation Taxes." Transportation Quarterly. 57 (1): 19.

Goldman, T., and Deakin, E. (2000). Regionalism through partnerships? Metropolitan planning since ISTEA. Berkeley Planning Journal, 14(1).

Hill, Mary V., B. Taylor, and M. Wachs (1999). Almanac, ACCESS 14, University of California Transportation Center, Berkeley.

Hofstadter, R. (1955). *The age of reform: From Bryan to FDR* (Vol. 95). Vintage.

Huang, Albert. The 20th Anniversary of President Clinton's Executive Order 12898 on Environmental Justice. Natural Resources Defense Council blog, February 10, 2014. https://www.nrdc.org/experts/albert-huang/20th-anniversary-president-clintons-executive-order-12898-environmental-justice

Jackson, Kenneth T. (1985) Crabgrass Frontier: The Suburbanization of America. Oxford University Press.

Johnston, R. A. (2004). The urban transportation planning process. The Geography of Urban Transportation, 3, 115–140.

Jones, David W., Urban Transit Policy: An Economic and Political History, New York: Prentice Hall, 1985.

——— (1989). "California's Freeway Era in Historical Perspective," Institute of Transportation Studies, University of California, Berkeley.

Kain, J. F. (1990). Deception in Dallas: Strategic misrepresentation in rail transit promotion and evaluation. Journal of the American Planning Association, 56(2), 184–196.

Kotter, J. P., and Schlesinger, L.A. (1979). Choosing strategies for change. Harvard Business Review, pp. 106–114.

Lovell, H. (2017). Are policy failures mobile? An investigation of the Advanced Metering Infrastructure Program in the State of Victoria, Australia. Environment and Planning A: Economy and Space, 49(2), 314–331.

Lundblad, Jennifer P. A Review and Critique of Rogers' Diffusion of Innovation Theory as It Applies to Organizations. Organization Development Journal Vol. 21, Iss. 4, (Winter 2003): 50–64.

Mansfield, Edwin (1995). Innovation, Technology and the Economy. Edward Elgar Publishing Limited.

Marsden, G., Frick, K. T., May, A. D., & Deakin, E. (2011). How do cities approach policy innovation and policy learning? A study of 30 policies in Northern Europe and North America. Transport Policy, 18(3), 501-51.

Massachusetts Institute of Technology (1974). Oral History Program, oral history interviews on MIT-California Division of Highways Project.

McCullen, J., Rucklidge, A. M., Bale, C. S., Foxon, T. J., & Gale, W. F. (2013). Multiparameter models of innovation diffusion on complex networks. SIAM Journal on Applied Dynamical Systems, 12(1), 515–532.

Meyer, M. D. (1999). Demand management as an element of transportation policy: using carrots and sticks to influence travel behavior. Transportation Research Part A: Policy and Practice, 33(7-8), 575-599.

Nelson, Arthur C. (2017). Transit-Oriented Developments Make a Difference in Job Location, Fordham Urban Law Journal. 44: 1079-1102.

Pfeffer, J. (1985). Organizational demography: Implications for management. California Management Review, 28(1), 67-8.

Pfeffer, J. (1992). Managing with power: Politics and influence in organizations. Harvard Business Press.

Pickrell, Don H., "A Desire Named Streetcar: Fantasy and Fact in Rail Transit Planning." Journal of the American Planning Association, 58(2), Spring 1992, pp. 158-176.

Piderit, S.K. (2000, Oct.). Rethinking resistance and recognizing ambivalence: a multidimensional view of attitudes toward an organizational change. Academy of Management, 25(4).

Poole, Robert, "Letting States Keep Gas Tax Money, Opt Out of the Highway Trust Fund," Reason Foundation, Apr. 29, 2009. https://reason.org/commentary/letting-states-keep-gas-tax-mo

Pressman, J. L., and Wildavsky, A. (1984). Implementation: How great expectations in Washington are dashed in Oakland; Or, why it's amazing that federal programs work at all, this being a saga of the Economic Development Administration as told by two sympathetic observers who seek to build morals on a foundation (Vol. 708). Univ of California Press.

Riedl, Brian (2021). Devolution: Four Proposals to Empower States and Reduce Washington's Political Strife. Manhattan Institute, Report: April 2021. https://media4.manhattan-institute.org/sites/default/files/proposals-empower-states-and-reduce-political-strife-BR.pdf

Rodrique, John-Paul (2013). The Geography of Urban Transport Systems. London: Routledge.

Rogers, E. M. (1962, 2003). Diffusion of innovations. Simon and Schuster.

Saltzman, Arthur, "Public Transportation in the 20th Century," in G. Gray and L. Hoel, Eds., Public Transportation (2d ed.), Englewood Cliffs, NJ: Prentice Hall, 1992, pp. 24-45.

Smerk, George M., "Public Transportation and the City," in G. Gray and L. Hoel, Eds., Public Transportation (2d ed.), Englewood Cliffs, NJ: Prentice Hall, 1992, pp. 3-23.

Sperling, D. (2018). Three revolutions: Steering automated, shared, and electric vehicles to a better future. Island Press.

SRI International, Evaluation of the Organizational Structure and Management Practices of the California Department of Transportation Volume I: Summary and Recommendations. February 1994.

SSTI, The California Department of Transportation: Assessment and Recommendations. January 2014.

State of California (2020). 2021 Five-Year Infrastructure Plan. https://www.ebudget.ca.gov/2021-Infrastructure-Plan.pdf

Strebel, P. (1996, May/June). Why do employees resist change? Harvard Business Review 86-92.

Taylor, Brian D., "Why California Stopped Building Freeways," ACCESS 3, University of California Transportation Center, Berkeley, Fall 1993.

US Environmental Protection Agency (EPA) (2021). Current Nonattainment Counties for All Criteria Pollutants-Data is current as of September 30, 2021. https://www3.epa.gov/airquality/greenbook/ancl.html

Utterback, J. M., and Suárez, F. F. (1993). Innovation, competition, and industry structure. Research Policy, 22(1), 1-21.

Volker, J. M., Lee, A. E., & Handy, S. (2020). Induced vehicle travel in the environmental review process. Transportation Research Record, 2674(7), 468-479.

Wachs, Martin, and Crawford, Margaret, Eds. (1991). The Car and the City: The Automobile, the Built Environment, and Daily Urban Life. Ann Arbor: University of Michigan Press.

Warner, S.B. (1978). Streetcar suburbs: The process of growth in Boston, 1870–1900 (Vol. 133). Harvard University Press.

Webber, Melvin (1976). "The BART Experience: What Have We Learned? Institute of Urban and Regional Development, University of California, Berkeley, Monograph No. 26.

Weiner, Edward (1984). Urban Transportation Planning in the U.S.: An Historical Overview. Part 1, Transport Reviews 4(4), pp. 331–338.

——— (1985). Urban Transportation Planning in the U.S.: An Historical Overview. Part 2, Transport Reviews 4(4) pp. 19–48.

——— (1992). "History of Urban Transportation Planning," in G. Gray and L. Hoel, Eds., Public Transportation (2d ed.), Englewood Cliffs, NJ: Prentice Hall, pp.46–78.

Wetzel, Edward G. (1965). The Three C's of Urban Transportation Planning. Port of New York Authority.

Zuk, M., Bierbaum, A. H., Chapple, K., Gorska, K., Loukaitou-Sideris, A., Ong, P., & Thomas, T. (2015, August). Gentrification, displacement and the role of public investment: a literature review. In Federal Reserve Bank of San Francisco (Vol. 32).

Appendix

Milestones in the History of Transportation and Land Development in the US and California

Early years	Native Americans traveled by foot, canoe, and dugout boat, and after about 1650, by horse. Some canoes were capable of carrying up to 18 people or hundreds of pounds of goods and materials. Native Americans also developed trails and roads, some of which were paved, and in some areas built bridges and canals. Colonists, arriving in what is now the US as early as 1500 (in Puerto Rico), also traveled primarily on foot or boat, or by pack animals on trails and roads, which were mostly unpaved.
1642	Ferry service using rowed skiffs is established between New Amsterdam and Breuckelen (now known as lower Manhattan and Brooklyn Heights).
1654	Responding to complaints about unsafe conditions, price gouging, and unreliable availability in the highly competitive ferry service market, New Amsterdam (now New York City) begins regulating ferries.
1662	Blaise Pascal introduces a public horse-drawn bus with established routes and schedules.
1700s–early 1800s	Most roads were built and maintained if, where, and when desired by landowners in the South; in contrast, public roads were mandated by towns in North, with maintenance paid for and delivered by required days of road work, in-lieu payments, or fines.
Late 1700s–early 1800s	Steam engines are developed for ships and rail transport. New York State legislature grants John Fitch exclusive rights to operate steamboats in state waters, but in 1803 voids these rights due to inaction and grants exclusive rights to demonstrate this new technology to Robert Livingston and Robert Fulton.
1786–1845	Toll bridges and turnpikes are built mostly under state charter by private corporations in the northeastern states, Virginia, and Ohio. Returns on investment were often poor, but investors reported civic pride as a motivation. States created many exemptions from tolls (e.g., for trips to funerals, church, or city hall).
1790	US Patent Office is established to protect inventors in response to a petition from John Stevens, a lawyer and inventor who also was Robert Livingston's brother-in-law.
Early 1800s	First bicycles are developed, although some credit contraptions developed hundreds of years earlier as bicycle predecessors, and some argue that the first "true" bicycle did not appear until the 1830s, or even later.
1807	Fulton operates a steamboat "performing her voyage without sails, and in opposition to the wind and tide" between Albany and New York City at 5 mph, three times faster than sailing. His correspondence that year notes the potential for economic development using steamboats on the Mississippi and Missouri rivers, and he begins development of torpedoes "for attack and defense."
1806–1839	The Cumberland Road, also known as the National Road or National Turnpike, is authorized in 1806 to support westward expansion. Construction began in 1811 and continued until 1839, reaching Illinois. The road was built with a foundation of broken stone, a design developed by the Scottish engineer John MacAdam that proved capable of carrying heavy loads without rutting. Competition from faster railroads led to the termination of the road's expansion, but as automobile use grew, parts of the right-of-way were used for US Route 40.
1811	Stevens's steam-powered commuter ferry begins operation between Hoboken, NJ and Manhattan.

1825	The Erie Canal opens, providing a direct water route from New York City to the Midwest. The canal triggered large-scale commercial and agricultural development and immigration to the western frontiers and transformed New York City into the country's leading economic center. Construction experience building the canal helped develop the field of civil engineering and led to the founding of the first civil engineering school in the US, Rensselaer Polytechnic, in 1824. Previously, the country's only engineering program was at West Point. The Erie Canal's construction and the development it supported dispossessed and displaced many Native Americans.
1825	The Stockton and Darlington Railway in northeast England becomes the world's first public railway to use steam locomotives, carrying coal at speeds up to 15 mph. Passengers were officially to be carried in separate coaches and initially were pulled by horses, but at launch, several hundred passengers sat on top of the coal cars to participate in the steam engine's first trip.
1820s–1840s	US interests followed British rail developments closely. In the US, the US Army Corps of Engineers is the main repository of engineering know-how for railroad building. Corps engineers led the design, right-of-way selection, construction, and organizational management for numerous rail projects. Many of these West Point engineers became prominent railroad officials. During this period, Massachusetts developed a plan for rail, and Massachusetts and other states authorized rail companies to use eminent domain to obtain right-of-way.
1830	Liverpool Manchester Railway is first interurban steam-powered railway, carrying both passengers and goods. In the US, John Stevens tests a steam-powered locomotive on a circular track in Hoboken and shows that steel on rail can maintain traction.
1830	The Baltimore and Ohio (B&O) railroad, chartered in 1927, opens as the first common carrier railroad in the US, offering passenger and freight service. Earlier US railroads were private carriers that transported building materials, coal, and agricultural products and often linked rivers to ports or canals.
1833	The 4.5-mile New Orleans and Carrolton Railroad begins carrying passengers to the resort village of Carrolton. The railroad is eventually absorbed into the New Orleans streetcar system as the St. Charles Avenue line and is the oldest continually operating passenger rail line in the world.
1830s–1870s	Rail systems are built throughout the US. The North and Midwest built an extensive network of intercity lines while in the South, many of the projects were short lines linking market centers to ports.
1840s–1850s	Plank roads (usually tolled) are built in the Mid-Atlantic and Midwestern states.
1850s–early 1900s	Toll roads are built in western states. California authorizes over 400 toll road incorporations and actually builds 159 privately owned toll roads. By the turn of the century, however, sentiment had turned against tolls, and many were abandoned or taken over by government.
1852	Elisha Otis develops the elevator, making tall buildings (over 6 floors) and deep tunnels (as used in deep tunnel transit subways) practical.
1861–65	Civil War rages, and transportation plays a critical role. Railroads and steamboats are used to move soldiers and supplies. The Army Corps of Engineers develops designs and processes for rapid emergency repair of rail lines and roads. Ships and submarines are used in battles. The first ambulance services are developed.
1862	Etienne Lenoir develops a gasoline-powered motor vehicle.

1862	Abraham Lincoln signs the Pacific Railroad Act of 1862, supporting the construction of the first transcontinental railroad in North America. The Act and subsequent amendments over the next three years authorized government bonds, allowed charter rail companies to issue their own bonds with precedence over government bonds, gave the railroads large land grants (ultimately, more than 175 million acres of public land—an area larger than the state of Texas), and mandated a standard rail gauge to match the gauge popular in the northeastern US.
1863	The first underground (metro) line with steam engines opened in London.
1868	George Westinghouse develops compressed air brakes for passenger and freight trains.
1873	Cable cars open in San Francisco.
1885	Karl Benz develops a motor vehicle with an internal combustion engine.
1884	East Cleveland Street Railway is the first electric streetcar.
1887	Interstate Commerce Act makes railroads the first industry subject to federal regulation. The Act had been preceded by state regulations in many parts of the Midwest and South. Initially focusing on prohibition of discrimination in access to services and requiring publication of rates, subsequent federal legislation over the next several decades expanded regulation to cover rates charged, labor practices, and mergers and abandonments.
~1885–1940	Age of Reform: Progressive Movement introduces initiatives, referendums, commissions to oversee government action, and a city manager style of government.
1888	The first electric streetcar line with gradients and many cars in operation opens in Richmond, VA.
1892	San Francisco and San Mateo electric railway opens—the first electric streetcar to serve San Francisco.
1893	Federal Office of Road Inquiry is established in the Dept. of Agriculture, indicating a renewed interest in roads at the federal level. Actions include promulgation of best practices in road building and support for engineering training. The Office later becomes the Bureau of Public Roads in the Dept. of Commerce, and later, the Federal Highway Administration.
1893	Electric streetcars replace horsecars on Market Street in San Francisco.
1894	Boston creates the first public transport commission.
1894	Cities across the world invest in electric-powered streetcars and heavy rail systems.
1896	US Supreme Court decision Plessy v. Ferguson (163 U.S. 537) allows "separate but equal" accommodations of people of different races.
Late 1800s–early 1900s	Many auto manufacturers compete for market share, using a variety of technologies and energy sources (steam, electric, diesel, gasoline). Motor vehicles are hand-built and expensive.
Late 1800s–early 1920s	Advances in bicycle design (in particular, the safety bicycle) make cycling easier and safer, and cycling booms. Cyclists lobby for road improvements, especially paving.
1903	The Wright brothers (bicycle builders) complete the first successful powered, piloted flight.
1903	New York City takes over the Staten Island Ferry from the Vanderbilts after a second disaster with loss of life—the first recorded public takeover of a major urban transit service. Also, first motorbus line begins operating on NYC's 5th Avenue.

1905	Henry Ford develops the assembly line, allowing mass production of automobiles, and begins production of the Model T motorcar.
1908	The San Francisco Municipal Railway is established—the first major public transit system in the US. (Bismarck, ND had a state operated street railway in 1904, and Monroe, LA was the first municipally owned street railway.)
1912	Jitneys (shared taxi services) compete with rail transit in San Francisco, Bakersfield, and other cities, but are quickly banned in most locales.
1914–1915	The first Federal Aid Highway Act is enacted, providing a 50-50 match (federal-state funding).
1916	World War I results in increased use of transit.
1916	Oregon introduces the first state gas tax. In the next decades, all other states and the District of Columbia followed suit, in most cases, hypothecating the tax for highway purposes only.
1914–1918	World War I results in increased use of transit. President Wilson nationalizes the railroads during the war effort.
1919	Model T sales reach 2 million a year, and the price drops below $400 (half the price in 1908).
1920s	Motorbuses begin to replace many streetcar lines, a trend that continues over the following decades.
1920s	The Federal Aid Highway Act calls for states to prepare a system plan of highways in order to receive federal aid.
1921	US public transportation provides an estimated annual 17.2 billion passenger trips.
1926	Overexpansion, heavy regulation, and labor problems result in failing transit companies as automobiles capture increasing shares of the transport market.
1915–1930	The Great Depression limits private investment in most transit systems, but the Roosevelt Administration builds several important transit projects as jobs projects.
1929–1930s	Urban bus ridership exceeds urban rail ridership for the first time.
1934	Federal Housing Act aims to make housing more affordable and forestall foreclosures, but helps mostly whites.
1936	The San Francisco–Oakland Bay Bridge opens.
1937	The Golden Gate Bridge opens.
1937	Housing Act establishes subsidies for public housing.
1940	First stretch of the Pennsylvania Turnpike opens.
1940	US public transit provided 23.4 billion trips.
1941–1945	US engagement in World War II restricts auto building, imposes gas and tire rationing, and results in heavy use of transit, but little maintenance.
1946	Passenger jets begin to ply US airways.
1956	Second wave of private transit decline as operators run deficits, consolidate or close. Public agencies take over some of them.
1940s–1960s	Suburbanization accelerates in the US, supported by highway building and housing policies. Much of the growth occurs at densities that are costly and inefficient for transit to serve.

1949	Housing Act funds urban renewal programs and "slum clearance."
1940s–2000s	Advent of the modern (first generation) computer for business uses.
1950s	Federal Aid Highway Act of 1956 authorizes a 41,000-mile Interstate Highway System. Federal funding of 90% of the cost is to be paid for through a highway trust fund created by earmarking federal fuel taxes. A 1-cent federal gas tax increase helps pay the bill.
1950s–1970s	Opposition to freeway construction appears in San Francisco, Boston, Atlanta, and numerous other cities across the US. In California, freeways are canceled in San Francisco, Berkeley, Oakland, Los Angeles, Sacramento, San Diego, and Orange County, and many others are forced to be redesigned or heavily mitigated.
1954	US Supreme Court decision Brown v. Board of Education (347 U.S. 483) declares that state supported segregation is a violation of the 14th amendment, repudiating (but not overturning) Plessy v. Ferguson (1896) "separate but equal" facilities.
1954	California Legislature approves planning of a regional rapid transit district in the San Francisco Bay Area.
1954	Federal Housing Act of 1954 authorizes grants for comprehensive city and regional planning.
1956	San Francisco Bay Area Rapid Transit (BART) Commission issues final report arguing that any transportation plan must be coordinated with the area's plan for future development, and because no such plan existed, prepared one itself. The plan was adopted a decade later by the Association of Bay Area Governments.
1957	Authority for railroads to discontinue service is transferred by federal law from states to the Interstate Commerce Commission. A spate of rail passenger services is discontinued across the US in the aftermath.
1958	AC Transit takes over from the Key System and its predecessors, which carried passengers via buses, horse-drawn rail, electric streetcars, and ferries over the previous 100 years.
1960	Omnibus Housing Act includes loans and grants for transit demonstration projects as part of urban renewal efforts.
1960s–70s	Push for democratization of decision-making, citizen participation, and civil rights combine with protests against urban freeways, redevelopment projects, discrimination in jobs and housing, and the draft and Vietnam War. Mass rallies and marches often involve civil disobedience and, in some cases, violence. Requirements for public involvement in planning and project selection are ramped up.
1961	Voters approve a bond to build BART in Alameda, Contra Costa, and San Francisco counties.
1962–64	US Supreme Court cases Baker v. Carr, Reynolds v. Sims, and Wesberry v. Sanders apply one person–one vote principle to federal and state voter districting and state legislatures. One consequence is urban interests gain a stronger voice.
1962	California Legislature creates special districts for transit in many areas. Also under CA law, any city together with unincorporated territory, or two or more cities, can organize and incorporate as a transit district. Districts take over failing private transit companies to keep service running.
1962	Federal Aid Highway Act calls for a long-range transportation plan for all areas over 50,000 population, coordinated with anticipated development and developed through a continuing, comprehensive metropolitan transportation planning process carried out cooperatively by the state and local communities.
1962	California's Collier-Unruh Act allows counties to increase the in-lieu tax by .5 cents to develop rapid transit systems.

1963	Urban Mass Transportation Act creates federal agency and capital funding for transit.
1964	Landmark Civil Rights Act of 1964 is finally signed into law.
1964	Shinkansen opens in Japan, offering first high-speed rail service at 210 km/h (later increased to 300 km/h).
1964	US Department of Transportation is created.
1965	Department of Housing and Urban Development is created.
1967	Federal Highway Administration confirms policy allowing reserved lanes for buses on federal aid highways including the Interstates, and permits opening up such lanes to a limited number of other vehicles.
1967	Federal Aid Highway Act includes TOPICS program, which provides for traffic operations and management, including transit priority treatments and transit stop improvements on urban arterials and local streets.
1968	Civil Rights Act includes fair housing provisions aiming to prevent discrimination in housing; other sections aim to improve rights for Native Americans.
1968	National Environmental Policy Act passes, creating federal requirements for environmental reporting and consideration of alternatives.
1969	Sharp increase in scope and tasks for transportation, especially for transit: provide access to jobs, especially for low income and those who cannot drive; support livable cities; provide transportation for elderly and disabled for all trip purposes; help reduce transportation environmental impact.
1970s	Paratransit, usually small buses and vans, begins to be provided as a dial-a-ride service.
1970s	Clean Air Act Amendments of 1970 require states to achieve national ambient air quality standards, using transportation control measures if needed.
1970	Urban Mass Transportation Assistance Act establishes substantial federal funding for transit and guarantees labor protection negotiations in public transit agencies.
1970	The first high occupancy vehicle lane in California opens on the western approach to the Bay Bridge toll plaza.
1970	The Mills-Alquist-Deddeh Act (SB 325), also known as the Transportation Development Act (TDA), is enacted in California, creating a Local Transportation Fund derived from a statewide .25 cent sales tax. TDA is later amended to include the State Transportation Assistance Fund (STA) and Local Transportation Fund (LTF), financed through sales taxes on motor vehicle fuels.
1970s	Cities across California install traffic calming devices on local streets and are sued because the devices are not in the Manual on Uniform Traffic Control Devices. The Legislature (Bates) responds with a bill declaring that traffic calming street designs are not devices subject to the manual.
1971	Federally subsidized intercity rail passenger service (Amtrak) begins.
1971	Transit ridership drops to its lowest in the 20th century.
1972	The Urban Mass Transportation Administration issues its External Operating Manual, which states that near term objectives are to increase the mobility of nondrivers and, in larger urban areas, to reduce congestion and improve quality of life. To be fully eligible for federal funding, urban areas needed to have a certified 3-C planning process involving local elected officials and a long-range plan consistent with urban development plans.
1972	Revenue service begins on BART Sept. 11, 1972, the first computer-controlled rail transit system.

1972	Federal Aid Highway Act allows urban areas to relinquish funds for Interstate highway projects in return for funds for transit. The act also strengthens the role of MPOs in project selection.
1973	Santa Clara County Transit District, approved by the Legislature in 1969 and by voters in 1972, takes over three struggling private transit operators.
1973–74	The OPEC oil embargo leads to new concerns about energy prices and availability; inflation skyrockets.
1973–74	Section 504 of the Rehabilitation Act states that no person who is otherwise qualified should be discriminated against in federal-aid projects. The Urban Mass Transportation Administration begins developing guidance, issuing a statement first in 1976 and with tougher requirements in 1979, which transit agencies opposed largely because of costs involved, leading to a court decision that the UMTA had exceeded its authority.
1973	National Mass Transportation Assistance Act authorizes the use of federal funds for transit operating assistance, mandates an integrated highway and transit 3-C planning process, requires that off-peak fares for the elderly and handicapped be half price, and creates a transit data reporting system.
1974	Sacramento Regional Transit District begins operations.
1974	Energy Policy and Conservation Act directs the USDOT to promulgate corporate average fuel economy (CAFE) standards, raising fuel efficiency from 18 mpg in 1978 to (a planned) 27.5 mpg by 1985. Other provisions of the act included promotion of carpooling and vanpooling.
1974	Housing and Community Development Act creates a block grant program merging smaller programs and awarding funds to localities based on formulas. The program aims to address housing and urban blight but also includes anti-poverty programs.
1975	UMTA and FHWA issue joint highway and transit planning regulations calling for a regional transportation plan that includes a long-range element and a short-range Transportation System Management element, including actions to make efficient use of road space, reduce demand in congested areas, and improve transit services and efficiency.
1975	Federal Aid Highway Act allows funds to be spent on maintenance of highways (defines construction to include resurfacing, rehabilitation, and restoration).
1977	Clean Air Act Amendments of 1977 require MPOs to engage in transportation–air quality planning, consider a list of emission-reduction measures, including investments in transit, bikes, walking, traffic operations improvements, telecommuting, and clean fuels and vehicles, and to assure that regional transportation plans are consistent with air quality plans.
1977	Wheelchair lifts are installed on buses.
1977	California voters pass Proposition 13, sharply reducing property taxes.
1978	UMTA issues a policy on rail transit emphasizing alternatives analysis, demand management, coordinated land use planning for higher densities and urban revitalization, and incremental implementation of usable segments of a planned system.
1978	The federal Surface Transportation Assistance Act includes highways and transit in the same legislation for the first time. The Act includes funding for transit in nonurbanized areas.
1978	Federal Section 15 transit reporting requirement goes into effect with over 400 transit operators providing data on ridership, costs and revenues, organizational structure, safety, and operating performance.

1979	National Transportation Policy Study Commission issues report stating that funding is insufficient to meet future needs, that government overregulation is impeding private investment, and that federal involvement should be reduced.
1979	Federal government begins to retreat from involvement in transportation.
1980s	Microcomputers are used for quick response, simplified transportation analyses.
1980s	TDA is amended to include the State Transit Assistance (STA) fund, derived from the statewide sales tax on gasoline and diesel fuel.
1980	President Reagan issues an executive order delaying implementation of new regulations and allowing a Task Force on Regulatory Relief to develop procedures requiring benefit-cost analysis of all regulations.
1981	Surface Transportation Assistance Act raises the federal gas tax by 5 cents, with 1 cent going to transit; puts new emphasis on completion of the Interstate system; and redirects transit funding, creating a new formula grant program for planning, capital projects, or with some restrictions, operations. The Act also calls for greater involvement of the private sector in transit provision and directed USDOT to issue regulations setting forth minimum service requirements for the elderly and handicapped.
1981	San Diego's light rail transit line opens, the country's first modern LRT system.
1981	Congress begins earmarking UMTA capital grant funds for specific projects.
1982	President Reagan's Executive Order 12372, Intergovernmental Review of Federal Programs, does away with federal oversight of intergovernmental coordination and requires greater deference to state and local views on federal regulation.
1982–83	After years of debate about the role of paratransit, UMTA issues a policy statement supporting it as a supplement to conventional transit, a service suitable for special needs groups, and a possible substitute for conventional transit in low-density and rural areas.
1982	Draft regulations on services for the elderly and handicapped are issued, setting off bitter debates, with advocates for the disabled arguing for equal access, and transit interests arguing for less costly approaches.
1983	Responding to executive orders favoring minimalist federal approaches, FHWA and UMTA revise planning regulations to remove considerations not specifically required by law.
1983	UMTA revises its capital grant policy to prioritize projects with local funding support and a high-level of cost effectiveness, comparing capital investment proposals to a TSM alternative involving upgraded buses, parking management, etc.
1984	Reports from the National Council on Public Works Improvement document the poor state of repair of the nation's public works, including its transit systems, and the failure of funding to keep up with inflation and growth.
1987	Surface Transportation and Uniform Relocation Assistance Act passes over President Reagan's veto. The Act writes UMTA's capital grants prioritization procedure into law.
1987	First Sacramento light rail line begins operations.
1987	Light rail transit begins operation in San Jose.

1987	Loma Prieta earthquake causes collapse of one section of the upper deck of the San Francisco–Oakland Bay Bridge and damages freeways in Oakland and San Francisco, including the Embarcadero Freeway and the Central Freeway. BART is virtually undamaged and carries a 50% increase in passengers in the following months. The western span of the Bay Bridge is retrofit for additional earthquake safety in ensuing years, while the eastern span is replaced amid considerable controversy over the design and construction. The Embarcadero Freeway is removed and replaced with a surface boulevard and transit. The Central Freeway is also replaced with a boulevard.
1990s	Intelligent transportation systems begin to capture attention as well as funding from USDOT and Caltrans.
1990s	Modern carsharing programs take off in the US, allowing self-service, short-term auto rentals.
1990s	Proposition 111 increases the CA gas tax from 9 to 18 cents.
1990	California voters pass Proposition 116, Bonds for Passenger and Commuter Rail, which also provides funds for ferries, paratransit, and bicycle projects.
1990	Americans with Disabilities Act is signed into law, providing civil rights and requiring accommodation of disabled people. Title II applies to public transportation and requires the provision of paratransit services by public entities that provide fixed route services.
1990	The Blue Line, first of the Los Angeles metro area's new rail transit lines, opens.
1990	Clean Air Act Amendments of 1990 designate metro areas by severity of pollution violations and tighten requirements for planning while extending attainment deadlines for areas with the worst pollution problems, including most California metro areas. Buses are held to strict pollution controls.
1990	Intermodal Surface Transportation Act increases flexibility in spending and gives MPOs more say over transportation choices. The Surface Transportation Program and Congestion Mitigation and Air Quality funding categories are created; transit projects can compete for these funds.
1990s & ongoing	Private developers and cities test land development concepts, such as pedestrian pockets and transit-oriented development.
1991	The Southern California Rapid Transit District and the Los Angeles County Transportation Commission merge to form the Los Angeles County Transportation Authority – Metro.
1993	Northridge earthquake causes $20 billion in damage in the Los Angeles area and closes I-10. LA Metro buses and trains provide needed transportation for the affected populace.
1992	SB 1435 establishes the State Highway Operation and Protection Program as a dedicated fund for safety, rehabilitation, and maintenance projects.
1993	Federal gas tax is raised but not indexed to inflation.
1995	High occupancy/toll (HOT) lanes are implemented on SR91 in Orange County in 1995 and on I-15 north of San Diego in 1996, later spreading across the US.
1994	President Clinton signs Executive Order 12898 on Environmental Justice, requiring federal programs to consider the social equity of their actions.

1995–1997	Seoul introduces the first contactless transit card. Shortly thereafter, Hong Kong introduces the Octopus card, a reusable contactless stored value smart card for making electronic payments on ferries, buses, trains, and taxis. The Octopus card can also be used to pay for parking, fuel, fast food, store purchases, and access to public facilities. The card is also commonly used for non-payment purposes, such as school attendance and access to office and housing complexes.
1996	SB 1474 designates MTC, the state-authorized transit coordinator in the Bay Area, and requires MTC to adopt rules and regulations to promote the coordination of fares and schedules for all public transit systems and that every transit operator enter into a joint fare revenue-sharing agreement with connecting systems.
1996	California High-Speed Rail Act authorizes the planning of a high-speed rail network, finding that "the cost of expanding the current network of highways and airports fully to meet current and future transportation needs is prohibitive, and ...would be detrimental to air quality."
1996	Transportation Equity Act for the 21st Century passes; it continues the basic structure of ISTEA.
1997	SB 45 changes programming process, giving counties and MPOs more authority.
1998	LA voters ban the use of sales tax to fund rail transit projects (lifted by another vote in 2006).
1998	LA Metro implements bus rapid transit service on 26 routes.
2000–2002	Continued lack of consensus about the direction of the federal transport program and declining balances in trust funds leads to a series of short-term continuations of transport bills and transfers from the general fund to support transport programs.
2000s	Local ballot initiatives for transportation enjoy widespread success.
2000s	Real-time information systems and mobile apps begin to transform transit information, ticketing, and data collection.
2001	9/11 terrorist attack on the NYC World Trade Center and the Pentagon lead to heightened attention to transportation security on all modes.
2001	Proposition 42 passes, requiring that starting in 2008–09, CA gasoline sales tax revenues be allocated 20% to public transportation, 40% to projects funded in the State Transportation Improvement Program, and 40% to local street and road improvements, with half going to counties and half to cities.
2002	AB 857 establishes California planning priorities: promote equitable infill development within existing communities, protect the state's most valuable environmental and agricultural resources, and encourage efficient development patterns.
2002	LA Metro becomes the first agency in the US to deploy buses made of composite materials, which greatly reduce weight and increase fuel efficiency.
2003	Facebook, the online social networking service, is founded, creating a new means of communicating with friends and communities of shared interest.
2004	Google begins offering bus service for its employees. Other tech employers also provide shuttles.
2004	Safe, Accountable, Flexible, Efficient Transportation Equity Act – a Legacy for Users continues most elements of TEA-21.
2006	AB 32, the Global Warming Solutions Act, directs CARB to develop plans and regulations to reduce GHG emissions to 1990 levels by 2020.

2006	California voters pass Propositions 1A-E, which protect transportation funds from diversion and increase funding.
2007	Transit agencies in California begin to introduce reloadable contactless smart card systems, such as the Clipper Card in the San Francisco Bay Area, the Compass Card in San Diego County, and the Transit Access Pass in Los Angeles County.
2007	Caltrans adopts policies supporting bus rapid transit on state highways.
2007	California Complete Streets Act requires local governments to plan for a balanced, multimodal transportation network that meets the needs of all users of streets, roads, and highways for safe and convenient travel. The state's Office of Planning and Research adopts complete streets requirements for general plans consistent with the urban, suburban, or rural context.
2008	SB 375 directs MPOs to develop plans for reducing GHG emissions by adopting transportation and land use strategies that will reduce VMT.
2008	California voters approve Proposition 1A, The Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century, providing for the sale of $950 million in bonds for high-speed rail and connectivity projects.
2008	Los Angeles County voters approve Measure R, a .5-cent sales tax increase to fund county rail, subway, and freeway improvements.
2008	Severe recession hits. The Transportation Investment Generating Economic Recovery program, created as part of the American Recovery and Reinvestment Act, provides federal funding on a competitive basis for highway, transit, freight, port, bike and pedestrian, and multimodal projects. Through 2011, 18% of funds have gone to transit projects.
2009	Uber launches in San Francisco, allowing customers to submit a trip request, which is then routed to drivers. Controversy over Uber services focuses on failure to meet the same regulations as conventional taxis and labor issues vs. creation of a new, convenient transport service. Competitor companies, including Lyft, soon emerge.
2009	USDOT issues a policy statement supporting accommodation of bikes and pedestrians in transportation projects.
2009	SB 391 calls for "a comprehensive, statewide, multimodal planning process that details the transportation system needed [. . .] to meet objectives of mobility and congestion management consistent with the state's greenhouse gas emission limits and air pollution standards" and mandates that the state transportation plan address how the state will achieve maximum feasible GHG emission reductions, drawing on regional plans in identifying "the statewide integrated multimodal transportation system needed to achieve these results."
2010	75.6% of US households report having a computer, compared to 8.2% in 1984. 71.7% report accessing the internet, up from 18.0% in 1997. Use of computer-based transportation maps and schedules become commonplace.
2011	Jobs and Economic Improvement Through Environmental Leadership Act authorizes the Governor to certify qualifying projects as environmental leadership development projects eligible for streamlining CEQA compliance and judicial review.
2011	Moving Ahead for Progress in the 21st Century Act includes funding for state of good repair, asset management, and safety and makes bus programs a formula grant.

2012	86% of Americans own a cell phone; 51% use it for internet or apps. Younger people own and use technology more. Transportation services increasingly rely on smartphone and internet apps for information, scheduling, and payments.
2012	10.6 billion passenger trips were made on US transit systems.
2012	The Transportation Research Board lists system reliability, resilience, safety, GHG emissions, energy, environmental impacts, and effects of sprawl on the sustainability of the transport system as critical issues for the coming years.
2012	SB 535 directs that 25% of the proceeds from California's Greenhouse Gas Reduction Fund go to projects that provide a benefit to disadvantaged communities.
2013	Construction of the first phase of California's high-speed rail begins in the Central Valley.
2014	Uber has expanded to 55 countries and 200 cities and has spawned many look-alikes.
2014	The CA Transportation Plan - 2040 aims to produce a sustainable transportation system that improves mobility, strengthens communities, and enhances the quality of life.
2014	SB 486 requires Caltrans to develop a robust Transportation Asset Management Plan to guide SHOPP project selection and requires the CTC to adopt TAMP performance measures that reflect state transportation goals and objectives and review SHOPP projects accordingly.
2014 & ongoing	CARB partners with regional and local agencies and nonprofits to offer electric vehicle and alternative mobility options to low-income Californians.
2015	Construction of the Fresno River Viaduct in Madera County begins in 2015—the first permanent structure built as part of California high-speed rail.
2016	AB 1550 requires that 25% of Greenhouse Gas Reduction Fund revenues be spent on projects located in disadvantaged communities, with another 5% for other disadvantaged persons.
2016	SB 32 requires action to reduce GHG to 40% below 1990 levels by 2030. Companion bill AB 197 requires CARB rules and regulations to protect the state's most impacted and disadvantaged communities, consider the social costs of the emissions of GHGs, and consider monetary and nonmonetary incentives and compliance mechanisms.
2016 & ongoing	California Climate Investments projects include a variety of projects, including affordable housing, renewable energy, public transportation, zero-emission vehicles, environmental restoration, more sustainable agriculture, and recycling. At least 35% of these investments are made in disadvantaged and low-income communities and households.
2017	SB 150 strengthens the role of SB 375 Sustainable Communities Strategies in MPO plans, requires the MPOs to prepare periodic progress reports on implementation, and encourages Central Valley MPOs, which are established at the county level, to work together on planning efforts. CARB is required to periodically assess and report progress.
2017	SB 1, the Road Repair and Accountability Act, increases California fuel taxes and vehicle fees to generate additional funding for streets, highways, and other programs, with allocations to state transportation agencies and directly to counties and cities for local road maintenance, safety improvements, and complete street improvements, including facilities for bicycles and pedestrians.

2018	EO B-48-18 directs state government to meet a series of milestones toward a long-term target of 1.5 million zero-emission vehicles on California's roadways by 2025, and 5 million by 2030.
2020	The murders of George Floyd, Ahmaud Aubery, and Breonna Taylor lead to protests against systemic racism in the US and lead many public and private organizations to issue statements acknowledging past harms and pledging to do better.
2020	EO N-79-20 calls on state agencies to take actions to assure that all new cars and light-duty trucks sold in California by 2035 and beyond must be zero-emission vehicles, that port and railyard drayage truck fleets be zero emission by 2035, and that all other heavy-duty vehicle fleets be zero emission where feasible by 2045.
2020–21	COVID-19 pandemic results in job losses, closure of shops and restaurants, stay-at-home orders, and a massive reduction in travel, with international travel, air travel, and transit use especially hard hit. Telecommuting greatly increases, as does e-commerce. Federal funding mitigates some impacts. Impacts fall heavily on communities of color and essential workers. A vaccine is developed in record time and offers substantial protection to those who accept it. A return to previous norms is uncertain.
2021	Construction is underway on 119 miles of high-speed rail in the Central Valley, and environmental documents are complete for the additional miles needed to connect to Merced and Bakersfield. Commitments are made to complete right-of-way selection and the environmental documents for the 500-mile Phase One system by the end of 2022.
2020	A Pew Research Center study finds that 95% of American adults have a cellphone and 85% have a smartphone. About 75% have a computer at home, and about 82% have internet access at home. About 40% of younger adults and those with high school or less education often rely on smartphones for internet access.
2021	SB 7 continues CEQA-streamlining provisions of the 2011 Leadership Act through 2024 and extends benefits to small-scale housing projects.
2021	SB 9, the California Housing Opportunity and More Efficiency (HOME) Act, allows for more housing density by permitting two units per parcel of land and allowing homeowners to subdivide their properties, creating up to four units on a single lot.
2021	Congress passes an infrastructure bill that has the potential to be transformational. California will receive funds by formula and can compete for other funds, with total potential revenues for transportation on the order of $50 -$60 billion over five years.
2021	COVID-19 impacts lessen over the summer, and students return to in-person school, as do some members of the workforce. COVID spikes again in late fall, with new variants appearing, and severe infections and deaths occurring primarily in the unvaccinated. Global supply chains are disrupted.