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Overview and Summary:

**Twelve Trends for Consideration in
California's Transportation Plan**

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Twelve Trends for Consideration in
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This paper presents an overview of a dozen trends that have potentially significant consequences for California and its transportation plan for the next twenty years. The twelve trends discussed in the paper are:

1. A Growing Population
2. Demographic Change
3. New Patterns of Employment
4. Housing Location, Type, and Affordability
5. Change in the Central Valley
6. Changing Passenger and Household Travel Demand
7. Changing Patterns of Freight Transport
8. New Technologies
9. The Environment
10. Equity and Participation
11. Sustainable Transportation
12. The Funding Dilemma

The paper concludes with a brief discussion of the implications of these trends for transportation planning. More extensive discussions of the first nine trends and the issues they raise can be found in the detailed papers that follow this summary. The last three topics are not addressed in later papers here; separate studies are being conducted on these topics.

This paper and the papers it summarizes are intended to provide a review of key literature as well as background information and data on the topics covered. We clearly do not attempt to cover every possible trend that could affect the pace or location of growth and change in California – we do not discuss, for example, the possible effects of recession, competing demands for water, or whether the current problems with the state's electric power supply will be lasting. Nor are the papers designed to offer policy advice, although we do sometimes suggest interpretations of the data that have policy significance. Finally, each paper is written to stand on its own as a summary of trends and issues for the particular topic it addresses. In preparing the individual papers, we have drawn upon a variety of sources and reflect sometimes-differing perspectives and interpretations of events and possibilities, as does the literature on the topics. We have not attempted to force consensus across the papers when it does not exist in the literature and data. We nevertheless hope that the materials here will stimulate discussion and further analysis as California transportation plans are being developed.

1. A Growing Population

According to state projections based on updates of the 1990 census data, the population composition of California is expected to change dramatically over the next two decades. The total population is projected to increase by 51% from 1990 to 2020 to a total of 45 million. This scaling up of the population will affect every aspect of life in California, from jobs and housing markets, to demands for public infrastructure and services, to access to open space, to impact on the natural and built environments.

Specific characteristics of the population are also expected to change. The share of persons over 65 years of age will increase from 10% to more than 14% of the total population. Additionally, the Hispanic population is expected to increase from 26% of the total 1990 population to 39% in 2020, resulting from both immigration and domestic births.

The 45 million figure is a “best estimate”; various estimates for 2025 range from a low of 41.5 million to a high of 52.5 million. The differences stem from different estimates of fertility rates among particular ethnic groups as well as from different assumptions about economic growth.

In spite of these differences forecasters generally agree on these points:

- Out-migration to other states will continue to be roughly equal to migration from other states to California.
- International migration will continue to contribute to the state's growth.
- The largest source of growth will be from natural increase (births exceeding deaths.)

Population growth will not be even across the state. Just eight counties - Los Angeles, San Bernardino, Riverside, Orange, San Diego, Alameda, Contra Costa and Santa Clara - are forecast to account for more than 60% of the State's total population growth over the next 20 years. From a regional perspective, the two largest metropolitan areas, Los Angeles / South Coast and the San Francisco Bay Area, are expected to account for the majority of the state's growth.

2. Demographic Change

Along with the rising size of the state population, its composition is also expected to change over the next 25 years. Total state population is expected to grow by roughly 30%; key demographic groups, by age, race, and ethnicity, are expected to grow even more rapidly:

- The number of Californians under 18 years of age is projected to grow by 37%.

- Senior citizens are expected to increase as a share of the state's population. Forecasts for 2025 expect 58% more people between 55 and 64 years of age, and 51% more residents over 65 years old.
- Hispanics are expected to become the largest ethnic share of the state population. Projections expect the Hispanic population of the state to grow by 66%, reaching between 41% and 47% of the total state population by 2025.

The state's racial and ethnic groups have settled in specific areas, a pattern that is expected to continue and perhaps be accentuated over the next two decades:

- Nearly 100% of the state's blacks and Asians are located in urban areas, with high concentrations in the larger cities - San Francisco, Oakland, and Los Angeles.
- Hispanics are concentrated in agricultural areas of the Central Valley and outside of Monterey, and in parts of San Jose, Los Angeles, and San Diego.
- The population of American Indians is relatively low in the state of California; however, concentrations up to 50% can be found in some areas of the rural north.
- Californians who were born outside the US – 21.2% of the state in the 1990 Census - live primarily in the San Francisco Bay, Los Angeles and the Central Valley, and are over half the population in some census tracts.
- California residents with limited English language ability are located in primarily in the agricultural areas of the Central Valley and urban areas of the Bay Area and Los Angeles. While Spanish speakers were the majority of non-English speaking residents in 1990, literally dozens of languages are spoken in the state.

The first wave of data from the 2000 Census, released while this paper was in final review, confirms that these trends are holding up so far.

3. New Patterns of Employment

Changes in the economy have significantly altered patterns of employment in the state over the past twenty years: Global trading, newly developing market links with South Asia, growth in high-tech industries, decline in military spending, and e-commerce are just a few of the changes that have altered the size, scope, and location of work in California. Trends and forecasts suggest that changes over the next two decades will be equally significant.

Among all industries, services are the fastest growing sector and are expected to account for one job in three by 2008. Reflecting the diversity of the services sector, forecasts predict an increase in jobs at both the low-end of the pay scale (<\$30,000 per year) and at

the high-end (>\$100,000 per year). The low paying jobs are one factor in poverty in California, which has been increasing more rapidly in the state than in the nation as a whole and is concentrated in inner city census tracts and certain agricultural communities of the Central Valley, but found throughout rural areas of the state.

Like population growth, employment growth has been heavily concentrated in the South Coast and San Francisco Bay Area, and forecasts indicate that these two regions will continue to capture a large share of jobs. Also like population growth, much, but not all, of the employment growth in these metropolitan areas is occurring in outlying regional sub-centers (e.g. Riverside and San Bernardino in Los Angeles, Southern Santa Clara County, the Tri-Valley and Santa Rosa in the Bay Area).

Employment growth elsewhere in the state is far slower. In particular, with the exception of Sacramento, job growth in the Central Valley has been somewhat stagnant and is expected to remain so, reflecting losses of jobs in agriculture and other resource-intensive industries.

Unemployment is found in both urban and rural locales and is often concentrated, with jobless rates of up to 50% in some areas per the 1990 census. The 1990 census tracts with highest rates of unemployment were located in the Bay Area (West Oakland, San Jose) and the Central Valley (Sacramento, Stockton, Madera). People living in poverty also were located in these areas, as well as in Fresno, Sacramento and Los Angeles. Very high concentrations of poverty (up to 75%) were found in Bay View/Hunter's Point, West Oakland, and Richmond in the Bay Area, as well as Central Los Angeles and downtown San Diego.

4. Housing Location, Type, and Affordability

The projected increase of 13 million new residents, at the current housing to population ratios, would mean about 5 million additional households by 2020. Growth in households between 1997 and 2020 will be substantial in all five metropolitan areas within the state. However, the distribution of such growth among the regions will not be uniform: Greater Los Angeles is expected to account for 47% of new households, the San Francisco Bay Area accounting for 20%, the San Joaquin and Sacramento areas of the Central Valley together 16%, and San Diego 8% of the total household growth. The rest of the state is expected to accommodate only 9% of the growth.

The forecast distributions of population and households within the state do not consider housing constraints. However, significant constraints do exist, in two interrelated forms: land availability and affordability. These constraints could have major impacts on location choices, housing type choices, and travel patterns over the next decades.

The availability of land for housing is determined not only by physical suitability (e.g., floodplains and slide zones might be considered unsuitable or too costly for housing development), but also by state and local infrastructure policy and local government

policies on land protection, subdivision control, zoning, and development fees and exactions. Where land availability is restricted, land and housing prices tend to be pushed upward. In turn, developers may turn their attention to neighboring jurisdictions with fewer restrictions. Such spillover appears to be happening already in the counties adjacent to the San Francisco Bay Area, and in Kern County due to spillover from metropolitan Los Angeles.

In varying degrees of severity Alameda, Fresno, Kern, Los Angeles, Madera, Orange, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, Santa Clara, Solano, Stanislaus, and Yolo Counties are projected to run out of developable land for housing during the twenty year forecast period. This projection is based on a scenario that accounts for all developable and accessible land but excludes all wetlands, prime and unique farmlands, Q3 floodzones, and areas that are habitats to endangered species. The most land-crunched counties are Yolo (which currently has residential zoned land to accommodate only 47% of the projected housing demand within the county by 2020), Fresno (land for 51% of projected demand), Stanislaus (55%), Orange (64%), Los Angeles (65%), San Joaquin (66%), Madera (67%), and Kern (70%). Sacramento is moderately short of land (91%), and the other counties on the list somewhat so. Unless rezoning or other steps are taken to increase the supply and availability of land for housing in these counties, spillover and higher prices may result.

Reflecting land costs as well as other factors, housing affordability has become a serious problem in the state. By some estimates only about 35% of households can afford to own the “median house.” Households respond to this price squeeze by trading a long commute to lower priced housing, by shifting to a less costly housing type (e.g., townhouse or condo rather than single family detached), or by choosing a smaller house or apartment than they otherwise would prefer (sometimes to the point of crowding, especially for low income households.)

Given a strong preference for single family detached housing - in 1999, the growth in single family attached housing units was 58% of the total housing growth in the state, versus 26% growth in apartments or condominiums with more than 5 dwelling units – the longer commute option seems to be the preferred response for many middle class households, especially first-time homebuyers. Over time some of these commuters will move to a house closer to work, or will find a new job closer to home. Doubling up in existing units, sometimes to the point of severe crowding, is a strategy often employed by the poor. Public policies could increase the choices, however. In particular, infill housing in attractive urban neighborhoods and older suburbs is attractive to some market segments. Also, increasing housing density by a modest amount, i.e., from 4 to 6 units per acre, would still allow single family housing to be built but would save substantially on land and housing costs. Mixed use developments, focusing on creating an array of housing types served by a town center, could help with affordability and also make walking, biking, and transit more feasible.

5. Change in the Central Valley

While growth in the state's two largest metro areas, and particularly the outlying counties of those areas, is outstripping the growth in the Central Valley, the percent change in the Valley is large and dramatic. In addition, total growth is substantial in some counties: Kern, Fresno, Stanislaus, and Sacramento Counties are projected to increase by more than 250,000 people over the next 20 years. Sacramento County alone is expected to increase in population by 40% during this period.

Part of the population growth in the Central Valley is related to the expansion of the Los Angeles and San Francisco commuting sheds rather than employment growth in these areas. Growth in Stanislaus, San Joaquin and Kern Counties reflects this spillover effect. Additionally, public policies to substantially restrict the growth of housing and jobs in major urban areas could change such forecasts and create substantial spillover effects in some Central Valley counties. For example, Alameda County Measure C, passed in November 2000, effectively eliminates a development project that would have been home to more than 3000 people. It is uncertain whether growth management policies will refocus such development toward traditional urban centers or push it out to nearby cities in the Central Valley.

Among the effects of growth in the Central Valley is the loss of farmlands, some of them prime agricultural land. Agriculture accounts for 8.5% of California's income and 9% of its jobs; in 1998 the Central Valley contributed 60% of the value of the state's agricultural output. While productivity increases may offset some of the impact of farmland conversion to urban uses, the loss of culturally important landscapes and open space is not so easily offset. In addition, Central Valley growth puts pressure on the state's wetlands and fragments and stresses habitat for migratory birds and endangered and threatened species. Impacts on water supplies affect not just the Valley, but much of the state; about two-thirds of the state's population gets at least a portion of its drinking water from the Delta. While reductions in agricultural use and better stewardship practices should make more of the state's water available for population growth and environmental protection, reductions in water availability from other states will partly offset this. Water supply and quality, wastewater management, and runoff management will all be considerable management issues as the Valley grows.

Finally, rapid change in the Valley puts heavy demands on the Valley's institutions and processes of governance. Infrastructure and services in much of the Valley were developed to serve modest levels of demand, in keeping with small rural communities that dotted the landscape. Suburban lifestyles often clash with the noise and smells of agriculture and the slow maneuvers of farm vehicles, and suburbanites' expectations for services (e.g., garbage collection, street lighting, emergency response times) are often far more extensive than the (formerly) rural communities have provided. Suburban levels of development tax the available roads, schools, water systems, and other facilities and services. At the same time, in the case of roads, concerns that added capacity will merely accelerate exurban development are already leading to debates over road expansions. Managing these changes and expectations will be a major challenge for the Valley.

6. Changing Patterns of Personal and Household Travel

Profound changes in personal and household travel have occurred over the past two or three decades, and these changes have important implications for future transportation planning. Among the most important changes are the growth in travel not related to the journey to work and the heavy increase in auto ownership and use.

During the period from 1969 to 1995, work-related travel fell from 36% to 18% of all trips nationally. Meanwhile, non-work travel increased from 64 % to 82% of all trips nationally. Increasingly consumption and entertainment-oriented lifestyles are important factors driving this growth of non-work travel; from 1969 to 1995 consumer trips as grew from around 29 to around 44% of all vehicle trips nationally. These trends are not solely the result of the growth of disposable income over time; consumption of entertainment activities grew for nearly all income groups during the period from 1984 to 1998, with the largest growth found in the second lowest income quintile (the equivalent of the lower middle class or working class). This trend indicates a fundamental shift in choice priorities for lower income households, implying a change in lifestyle choice as well.

During the same period, auto use also grew dramatically. Growth in auto use reflects increasing levels of driver licenses for both men and women, a willingness to continue to drive well into old age, near-ubiquitous auto availability, and the location of activities in the suburbs in patterns that depend on the car for access. The growth in non-work activities also is implicated in the rapid increases in per capita and per household VMT, since these non-work activities are disproportionately made by car (or by walking, for shorter trips.)

Transit during this period lost market share overall, although gains were seen in some markets and recent data (1995-2000) show transit use increasing somewhat, especially on smaller systems. In California, one estimate is that ridership at the larger systems grew about 5% per year in the last few years. Immigrants to the United States form a disproportionate share of transit riders in California; in Southern California, the share of transit commuters who are recent immigrants increased from roughly 27 to 42 percent between 1980 and 1990 and is believed to have held steady or increased since then.. Low-income households also remain disproportionately transit-dependent.

7. Changing Patterns of Freight Transport

Freight transportation plays an important role in the California economy. Reflecting California's position as a major producer of high technology products, a larger share by value of California shipments is related to the high technology sector than the rest of the nation. The top ten list of shipments for the nation is dominated by commodities that serve as products of or factor inputs for industrial activities. By contrast, the top ten list of shipments for California is dominated by high value electronic equipment and other finished products.

Trucking dominates shipments in California to a greater extent than for the nation—it captures nearly 63% in ton-miles of California’s shipments compared to only 38.5% for the nation as a whole. When viewed in terms of the value of shipments in California, truck transport’s importance increases even more, capturing more than 67% of the value of all shipments. Trucking’s dominance appeared to grow during the 1990s in California as it increased its share from just under 55% to over 62% of all ton-miles from 1993 to 1997. However, in terms of the value of those shipments, the truck share of total shipments remained flat during the same period at just under 68%.

During the period from 1993 to 1997, the per unit value of rail’s share of California shipments fell while air freight and the use of multiple modes grew. Reflecting California’s position as a major gateway to the Pacific, water ports also play an important role in the state’s freight accounts. The Los Angeles-Long Beach ports are by far the most important ports for the state, capturing about 80 percent of all gross tons shipped to California in 1999. The vast majority of these shipments (80%) were containerized.

8. New Technologies

Electronics and telecommunications are rapidly changing and are having significant impacts on social and economic activity, with major implications for transportation. Just-in-time delivery requirements, for example, have revolutionized logistics, making their application a central feature of shipping; logistics innovations in turn have further revolutionized the shipping industry. These changes are having major impacts on businesses, from manufacturing to warehousing to retail sales. Transportation also is being changed by new technologies, as Intelligent Transportation Systems (including smart cards, on-board diagnostics and information systems, and smarter highways, transit, automobiles, logistics systems, and other information systems) are being implemented.

Technological changes over the next two decades could change transportation system user choices and behavior in important ways. Location of businesses and households may be altered as telecommunications options improve. Already, there is evidence that businesses have become less dependent on proximate locations as electronic links have become more effective alternatives to face-to-face communications. Freight carriers are heavy investors in new technologies and are using them to more efficiently implement the just-in-time, overnight, and same day services that are proliferating. Individual travelers are also using new technologies to pay tolls more conveniently and to find out the best route to their destinations. And while full-time telecommuting is relatively rare today, telecommunications systems do appear to enable many workers to “commute” from a home office on a part-time basis.

The range of options and their impacts will continue to expand as new technologies are introduced over the next two decades, and may alter transportation systems in many ways, large and small. For example, electric, hydrogen, or hybrid electric-petroleum vehicles may be introduced that would substantially alter emissions and fuel characteristics of the fleet, and potentially pose challenges in terms of system operations

and finance. Smart card technologies could greatly improve the feasibility and convenience of a variety of pricing options for road use, parking, and transit fares. Monitoring and information systems could enable travelers to time trips and select routes to avoid congestion, reducing it in the process. Advanced traffic management systems could increase road capacity significantly while improving safety and respecting other objectives such as pedestrian comfort. Over the longer run, automation could make order of magnitude improvements in safety, capacity, and convenience. Whether and to what extent these technologies become a significant element of the transportation systems will depend, however, not only on technological developments but on both public and private decisions about the technologies' desirability and usefulness. System-wide applications and high market penetrations of new technologies are likely to have vastly different benefits and costs than the piecemeal applications that are currently proceeding.

9. The Environment

Transportation impacts on the natural and built environment are increasingly important factors in transportation decision-making. Environmental considerations both constrain transportation actions and offer important possibilities for environmental enhancement. Over the next two decades, key environmental considerations that transportation agencies will need to address in future planning include:

- air quality
- water quality and supply
- protection of wetlands
- protection of parks, historic sites, and other cultural resources
- conservation of farmlands and other special lands
- protection and enhancement of scenic views
- protection of endangered and threatened species and their habitats
- enhancement of roadside ecology and reduction of severance effects, streambed effects, etc.
- noise reduction and noise management
- reduction of negative community impacts such as neighborhood traffic
- reduction of solid waste and hazardous waste generation
- recycling waste sites (superfund/ brownfields)
- recycling and use of recycled and other "green" materials
- reduction of CO₂ and other greenhouse gas emissions.

California has made substantial progress on some of these matters, but much more remains to be done.

Air quality provides an example of mixed results. Largely due to technological improvements in vehicle air quality controls and to regulation of industrial sources, peak ozone levels decreased in the state by 49 percent from 1980 to 1997, despite a 39 percent

increase in population and a 78 percent increase in the number of vehicle miles traveled each day. Still, seven of the ten most polluted urban areas, ranked by their average number of days with ozone concentration above the national 1-hour standard, are from California. The recent tightening of federal ambient air quality standards for particulates and ozone will further increase the number of areas of the state unable to achieve clean air.

The wetlands situation illustrates the environmental challenges the state must face. Estimates of wetlands that historically existed in California range from 3 to 5 million acres. The current estimate of wetland acreage is approximately 450,000 acres; an 85 to 90 percent reduction. Policies are in place to restore and/or preserve many of the remaining wetlands, but this requires both land conservation and water dedication – meaning less land for development and less water for other uses.

Finally, land use itself is increasingly seen as an environmental issue. Among the topics of salience are the following:

- the effects of transportation investments on the use of land, including induced demand, and infill, brownfields development, community reinvestment, growth management
- the effects of land use patterns on travel demand (e.g., sprawl and auto dependence; jobs-housing imbalance and congestion; compact growth as a means of facilitating walking, biking, and transit use)
- direct impacts of transportation facilities on land itself (land consumption, habitat fragmentation, run-off, etc.)

Increasingly, transportation agencies are responding to environmental challenges by redesigning their planning and project development procedures to incorporate environmental considerations early in the process. Many transportation agencies are working more cooperatively with environmental and resource agencies and local governments. Detailed environmental databases and the availability of GIS mapping capabilities are important support tools enabling planners to emphasize environmental protection and enhancement through environmentally sensitive design over after-the-fact mitigation.

10. Equity and Participation

Recent legislation and executive orders underscore the need for public agencies to identify and address the environmental and socioeconomic effects of their programs, policies, and activities. For transportation, TEA-21, the Transportation Equity Act for the 21st Century, calls for increased opportunity for citizen participation. Reflecting concerns that minority and low income populations are frequently underrepresented in public policy forums, directives to increase planning and outreach activities targeted at those

groups have been issued, including Presidential Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.” The Presidential Executive Order is based on the mandates of Title VI of the Civil Rights Act of 1964. State legislation also contains similar mandates, e.g., California Senate Bill 115 (1999.)

Several relatively new transportation programs likewise reflect the desire for broad participation in transportation decisions. TEA-21’s assignment of significant planning and decision authority to metropolitan planning organizations (MPOs), in partnership with state transportation agencies, strongly signaled a shift in federal policy toward an expectation of greater involvement of stakeholders. Federal law and regulations also underscore the need to involve both the public and private sector interests (including shippers, freight carriers, port users, etc.) in transportation planning. In California, the devolution of considerable transportation authority to counties, along with authority for self-help funding with voter approval, has further underscored the need for effective partnerships.

At the same time that requirements for participation have expanded, there has been a growing consensus that transportation planning must be broadly scoped and attentive not just to mobility and access but to also to the larger societal goals of social equity, economic development, and environmental quality. Programs and projects on regional visioning, congestion management and air quality, transportation enhancements, livable communities, sustainable transportation, traffic calming, brownfields redevelopment, and the like illustrate this interest in transportation’s role in community-building and environmental improvement. There is a growing consensus, moreover, that social, economic, and environmental goals should not be “handled” through special programs, but in fact should permeate the entire transportation planning process.

The growing emphasis on social equity and participation is leading to the development of new planning approaches that are based on greater stakeholder and community involvement and that better integrate land use, transportation, and economic investments. In addition, methods for assessing the incidence of impacts on diverse communities and for measuring the performance of transportation plans and projects from an equity perspective are increasingly important.

11. Sustainable Transportation

Scientists generally agree that increasing concentrations of greenhouse gases (water vapor, CO₂, methane, nitrous oxide, halocarbons) in the atmosphere are causing the average temperature of the earth to rise. The timing, magnitude, and consequences of this temperature increase are not fully understood or agreed upon, but most analyses have predicted that warming could be on the order of 1– 5 degrees Celsius within a century. Average temperature increases of this magnitude could produce marked changes in precipitation patterns, with accompanying disruptions in other natural systems. It is also possible that the frequency and violence of storms could increase. The resulting changes

could be rapid enough that neither natural systems nor social systems would be able to adapt easily. Some system changes appear to be underway already, including increased global mean surface temperatures and rising sea levels.

In response to this potential threat to social, economic, and environmental well-being, a series of international conferences have been held to develop a plan of action. The Kyoto Protocol, hammered out in 1997, set out targets for industrialized nations averaging out to about 5% below 1990 levels by the 2008-2012 period; for the US, the target level was to be a 7% reduction. However, the US did not confirm the treaties committing itself to action, and the current Administration has rejected the Protocol, preferring instead to find its own ways to achieve significant reduction in greenhouse gas emissions.

Finding these strategies to reduce greenhouse gases is likely to be a major challenge, particularly in light of the fact that, absent strong new action, emissions are projected to increase substantially over the next several decades. In the US transportation sector, for example, CO₂ emissions could nearly double by the middle of the next century unless technological changes are vigorously introduced or transportation demand is sharply curbed.

The United States, the largest energy user in the world, is also the largest emitter of CO₂, currently accounting for almost one-quarter of the total. US CO₂ emissions come from transportation activities, residential and commercial activities, and industrial processes in roughly even shares. US transportation activities, which the US EPA has estimated to be the largest single source of greenhouse gas emissions in the world, include both motor vehicle emissions and other transportation emissions (e.g., from jet aircraft); however, surface transportation alone is 25% of the US total. Three quarters of that 25%, or about 16% of greenhouse gas emissions, currently are from personal vehicle use.

A 1997 TRB study, drawing evidence from the literature on modeling studies and field experiments, suggests that transportation strategies could reduce greenhouse gas emissions as follows:

- From aggressive transportation demand management and land use planning strategies: 6% reduction by 2020, 15% by 2040
- From a 1.5% annual increase in average new vehicle fuel efficiency: 15-20% reduction by 2020, 35% by 2040
- From higher fuel prices amounting to a 3% increase per year: 20% reduction by 2020, 40% by 2040
- From the introduction of new low-emissions vehicles (5% of fleet by 2020, 35% by 2040): no significant change by 2020, 30% reduction by 2040.

In short, several strategic directions could reduce greenhouse gas emissions, but no one strategy by itself offers a “silver bullet” for the greenhouse gas emission problem.

The concept of sustainable transportation may offer a direction for making progress on greenhouse gases together with other important goals. Sustainable transportation reflects

the convergence of concerns about environmental quality, social equity, economic vitality, and the threat of climate change; while a variety of definitions of sustainability have been proposed, definitions that encompass the full set of community and environmental issues that are at stake are increasingly being put forward. One such definition of sustainable transportation is: transportation that meets mobility needs while also preserving and enhancing human and ecosystem health, economic progress, and social justice, now and for the future.

A variety of strategies have been identified for potentially increasing transportation sustainability, including demand management, operations management, pricing policies, vehicle technology improvements, clean fuels, and integrated land use and transportation planning. In the past, planning and implementation of such strategies has been slow and spotty, deterred by the complexities of the underlying issues along with uncertainties about the magnitude and timing of impacts, the efficacy of available courses of action, and the consequences of action or inaction. Recently, however, a new interest in actively pursuing these strategies has emerged, and several initiatives both here and abroad have developed plans and policies for sustainable transportation.

These plans and policies reflect a new approach to planning that:

- encompasses environmental stewardship and social equity concerns emphasizes policy harmonization among agencies and levels of government
- involves stakeholders and the public in planning that emphasizes consensus building
- uses visioning to reveal and develop shared goals and objectives
- tests scenarios and uses backcasting as well as forecasting to evaluate the effects of plans and projects
- applies performance measures to evaluate results
- treats planning as a continuous, experimental learning process conducted at a variety of scales.

12. The Financing Dilemma

Funding shortfalls for transportation challenge the ability of transportation planners to provide for the current and projected mobility and access needs of the state. The shortfalls are felt at every level of government, for capital projects as well as operations and maintenance.

Possible ways to address the financing dilemma are to raise the gas tax, continue and expand the use of sales taxes, raise fares and fees, increase private sector provision of transportation infrastructure and services, and use borrowing (e.g., bonds) instead of pay-as-you-go financing. While concerns about increasing taxes and fees are substantial, there does appear to be public support for increased investment in transportation as well as willingness to vote for higher taxes clearly earmarked for popular projects.

In addition, measures to moderate demand could reduce the need for new investments and thus could be given increased attention in transportation finance. Pricing strategies would not only reduce demand somewhat but generate revenues to fund transportation improvements. Road pricing, congestion pricing, emissions fees, and parking pricing have been studied extensively in California but have been tested in only a few locations and in limited applications (where they have proven to be quite effective.) In most other cases, the constituency for these measures so far has been unable to overcome political concerns about imposing higher costs on travelers.

Another approach is to encourage the use of alternate modes, especially where there is available capacity (e.g., empty bus seats, empty seats in private commuter vehicles for carpooling.) Where levels of service competitive with the automobile can be offered to potential users, these strategies do attract users and can provide relief to overburdened infrastructure. For example, casual carpooling across the Bay Bridge takes advantage of HOV bypass lanes to speed the trip into San Francisco from Berkeley, Oakland, and Orinda, is heavily used, and relieves pressure from both BART and the highway network. Finally, in some cases capacity can be provided at modest cost as part of a development process and can help support the use of alternate means of travel. For example, traffic signal timing, ramp metering, and other relatively low cost traffic management efforts can improve capacity and reduce delay. Similarly, sidewalks, bike lanes, and bus stops installed as part of the development process in new communities can make it possible for residents to use these alternatives conveniently and comfortably. While such approaches are often cost-effective and popular, the overall impact has proven to be modest (on the order of 5% reduction in delay for traffic signal retiming, and 2-10% reduction in auto trips for investments in alternative modes.) Thus these measures should be thought of as complements rather than substitutes for new investment.

New technologies offer a third way to deal with the finance problem, by increasing the effective use of existing facilities and services. Here, real time traffic control, real time traffic advisories and information systems, advanced fare collection systems, and advanced paratransit services with on-the-fly routing and scheduling are among the measures already being introduced to make better use of existing capacity and offer more reliable services to the public; additional advances will be available over the next two decades. However, it is necessary to find funding for systematic implementation of these systems before they can be fully effective; while emerging technologies will probably reduce the cost of future infrastructure and services compared to the costs without them, they too will require more funding than is currently available.

Implications for Transportation Planning

1. Even with the most conservative estimates California's population will grow by nearly 8 million over the next 25 years, an increase of almost 23%. This growth will result from natural increases and immigration. The expanded population will require transportation services.

2. Vehicle travel has historically outpaced population growth and is therefore almost certain to grow by as much as, or more than, population growth.
3. Much of the growth will occur in the Los Angeles and San Francisco metropolitan areas, increasing pressure on already heavily congested transport facilities that are costly or difficult to expand.
4. Growth projected for the Central Valley, while smaller than that of coastal cities, will represent a large change and will impact the environment, stress existing infrastructure, and challenge the management capacity of existing institutions.
5. The population will include an increased share of older drivers who have spent their entire adult lives traveling by automobile and may well be reluctant to give up the freedom of driving in spite of declining vision and/or physical capacity, raising safety concerns.
6. The population will also include an increased number of youth below driving age that will require transportation services.
7. Concentrations of low-income households in central cities, aging suburban centers, and the Central Valley are likely to translate into strong demands for public transportation systems to meet basic mobility needs.
8. Growth in non-work travel is likely to mean increasing travel during off-peak periods, and increasing dispersal of travel destinations.
9. Service jobs located in suburban centers and office parks will account for the largest share of employment. Most of these jobs will be accessed by auto.
10. Employment growth is likely to be focused in the service industries, which themselves are diverse; both high paying jobs and low paying jobs are being produced.
11. The shift toward a service economy favors truck and air freight modes.
12. High housing costs, caused in part by restrictions on housing development, may push many into long commutes, especially first time homebuyers, if affordable housing is predominantly available at the suburban fringe.
13. Major infrastructure improvements may be necessary to meet a doubling or even tripling travel demand in some corridors.
14. New technologies will offer important opportunities for improving transportation infrastructure and services.
15. New technologies also are likely to influence location decisions and travel patterns and choices of both businesses and firms.
16. Concerns about the environment will continue to strongly influence transportation plans and projects, and new planning processes to better reflect environmental considerations will increasingly be utilized.
17. Social equity concerns also will require new methods of involving stakeholders and the public, along with new methods of analysis and performance measurement.
18. The concept of sustainable transport may offer a way to resolve simultaneous needs for economic development, environmental improvement, and equity.
19. Partnerships and cooperative planning approaches are likely to become increasingly important.
20. New sources of funding for transportation will have to be secured to meet the challenges facing the state's transportation systems.

References

Several sections of the paper draw upon working papers presented in the later chapters, or on other work completed by the lead author. A few sections draw upon ongoing studies. The material summarized in each section draw upon the following.

Section 1: John Thomas and Elizabeth Deakin, California Demographic Trends: Implications for Transportation Planning, University of California, Berkeley, May 2001.

Section 2: John Thomas and Elizabeth Deakin, op cit.; Christopher Ferrell and Elizabeth Deakin, Changing California Lifestyles and Consequences for Mobility, University of California, Berkeley, May 2001

Section 3: Kai Wei and Elizabeth Deakin, Trends in California's Jobs, University of California, Berkeley, May 2001.

Section 4: Manish Shirgaokar and Elizabeth Deakin, California Housing Trends: Implications for Transportation Planning. University of California, Berkeley, May 2001.

Section 5: op cit. and ongoing work by the E. Deakin (not yet published)

Section 7: Christopher Ferrell, Songju Kim, and Elizabeth Deakin, California's Freight Patterns

Section 8: Songju Kim, E. Deakin, et al.: Transportation Technologies; Jonathan Mason and Elizabeth Deakin, Information Technologies and Implications for Urban Transportation

Section 9: John Thomas and Elizabeth Deakin, Addressing Environmental Challenges in the California Transportation Plan, University of California, Berkeley, May 2001.

Section 10: ongoing work by E. Deakin and J. Innes (not yet published)

Section 11: E. Deakin, Sustainable Transportation , series of papers and materials at www.uctc.net/sustrans

Section 12: ongoing work by Martin Wachs et al. (not yet published)