



# UNRAVELING TIES TO PETROLEUM:

## HOW POLICY DRIVES CALIFORNIA'S DEMAND FOR OIL

Understanding how policies determining everything from mortgage tax deductions to parking lots are intertwined with California's demand for oil

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**C**alifornia's energy paradigm is shifting in this new Millennium. The prior paradigm, energy use that tends to promote near-term economic development, no longer serves the state's economic and environmental policy goals. Thus, the state has evolved a new paradigm: energy use capable of sustaining long-term quality of life goals and economic security. As this paradigm shifts, the state, regions, counties, and municipalities have the opportunity to reevaluate legacy policies and their direct or indirect impact on energy use.

Moderating petroleum's effect on the state's economic and social systems will assist the transition to a clean economy, where the state can increase economic output while protecting limited natural resources. Rising fuel prices burden all Californians, especially those with little wealth or alternative transportation options. Understanding the connection between petroleum use and anthropogenic climate change provides an additional impetus to reduce California's consumption of petroleum.

*Unraveling Ties to Petroleum* presents an approach to understanding policy implications in a highly complex, layered and interwoven system. Urban form and travel activity is the result of the complex interactions over time, shaped by past policy choices. We seek to unravel path dependencies, interconnectedness, and multiple feedback loops in order to link petroleum consumption with policy decisions that, at first blush, may seem unconnected to energy use.

As policymakers pursue ever-more sophisticated goals, they must consider how pre-existing policies may erode the effectiveness of new policies. Incremental decision-making approaches often fail to address these adverse effects, which can undermine new policymaking efforts. *Unraveling Ties to Petroleum* supports policymakers looking to develop innovative new policies that support these goals, while at the same time actively addressing path-dependency.

In 2006, California resolved to reduce greenhouse gas emissions to 1990 levels by the year 2020. Seven years later in 2013, the state is now midway through implementing the Global Warming Solutions Act of 2006 (AB 32). In addition to developing new policies, the state can reevaluate existing policies in order to ascertain the direct and indirect effects that implicit and explicit policy choices have on California's petroleum use. As California works to meet the emission reduction goals of AB 32, the transportation sector, accounting for nearly 40 percent of the state's energy consumption and 86.4 percent of its petroleum use, will play a key role.

## **SUMMARY OF FINDINGS**

In this report, we consider 15 specific measures that affect petroleum used in transportation, analyzing how choices to add to, eliminate, or change an existing policy can impact statewide petroleum use. We focus primarily on on-road surface transportation and light-duty, private vehicles, but also include aircraft.

The legacy policies we assess appear in the U.S. Code, the U.S. Code of Federal Regulations, the California Constitution, various sections of California Code and

the California Code of Regulations, and in local code and directives approved without any legislative deliberation.

Some of the policy choices conceal the true cost of providing automobile infrastructure. For instance, **minimum parking requirements** create implicit user-subsidies when the cost of parking is bundled in the cost of other goods or services. In addition, **employer parking subsidies** hide parking costs from employees without always offering non-drivers a similar subsidy.

Other measures unintentionally perpetuate private passenger vehicle use – and associated petroleum consumption – while impeding the scope or quality of alternatives. For example, the methods that transportation departments employ to **assess the performance of the transportation system** continue to influence most traffic engineering decisions in favor of single-occupant automobiles. Furthermore, the **conventional approach to adding High-Occupancy Vehicle (HOV) lanes** through construction, rather than conversion of existing lanes, delays the implementation of HOV networks.

Among policy developments that help reduce California’s petroleum dependence, the introduction of **new services allowing travelers to share rides** and even share cars is particularly promising. Behind both of these programs is the relatively new idea of transportation as a service, allowing consumers the choice of foregoing the purchase, maintenance, and storage of a private vehicle. The savings for the state could be huge: filling just ten percent of the excess capacity of private passenger vehicles currently operating in California could lead to an 18 percent reduction in motor vehicle fuel use. Nonetheless, current regulatory and market barriers threaten the growth of new, Internet-enabled peer-to-peer ridesharing services.

Some measures combine to increase California’s reliance on oil. For instance, **minimum parking requirements** increase the number of parking spaces per acre in dense areas, with more parking spaces per acre leading to more traffic congestion. Policymakers then seek to mitigate this problem with **automobile-based transportation system performance standards**. These standards often seek to remedy congestion through roadway widening, but end up perpetuating traffic congestion in corridors where the public right-of-way is finite. Furthermore, these policies inhibit a shift toward transit use to increase the number of people traveling through congested corridors – even in high-quality transit areas.

In some cases, policies distort land use, compelling drivers to make longer trips and diluting the attractiveness of alternative modes. The **home mortgage interest deduction** may contribute to larger homes and larger lot sizes. Local planners possess a greater range of **financing mechanisms for public infrastructure improvements** needed in greenfield

areas than in infill areas, which have more complex financing needs. The location of **state enterprise zones** far from population centers may force workers to accept longer commutes. The **conventional approach to parking policy** – obliging each parcel to provide a minimum amount of parking – leads to large land areas devoted to parking, changing neighborhoods and transportation options.

Policies that govern how parking spaces are created and subsidized, how road space is allocated, how local governments fund infrastructure needed for infill development, and how automobile insurers charge premiums were found to be the most impactful in terms of driving petroleum demand in California. By addressing the top five policies listed above, California could reduce future petroleum use by at least 25 percent.

In some cases, reducing statewide petroleum use can be relatively simple, without any need for significant fiscal requirements, commitments or trade-offs. Caltrans or state legislature could allow transit buses to use highway shoulders. The Public Utilities Commission or state legislature could remove existing barriers for informal transportation systems, such as jitneys.

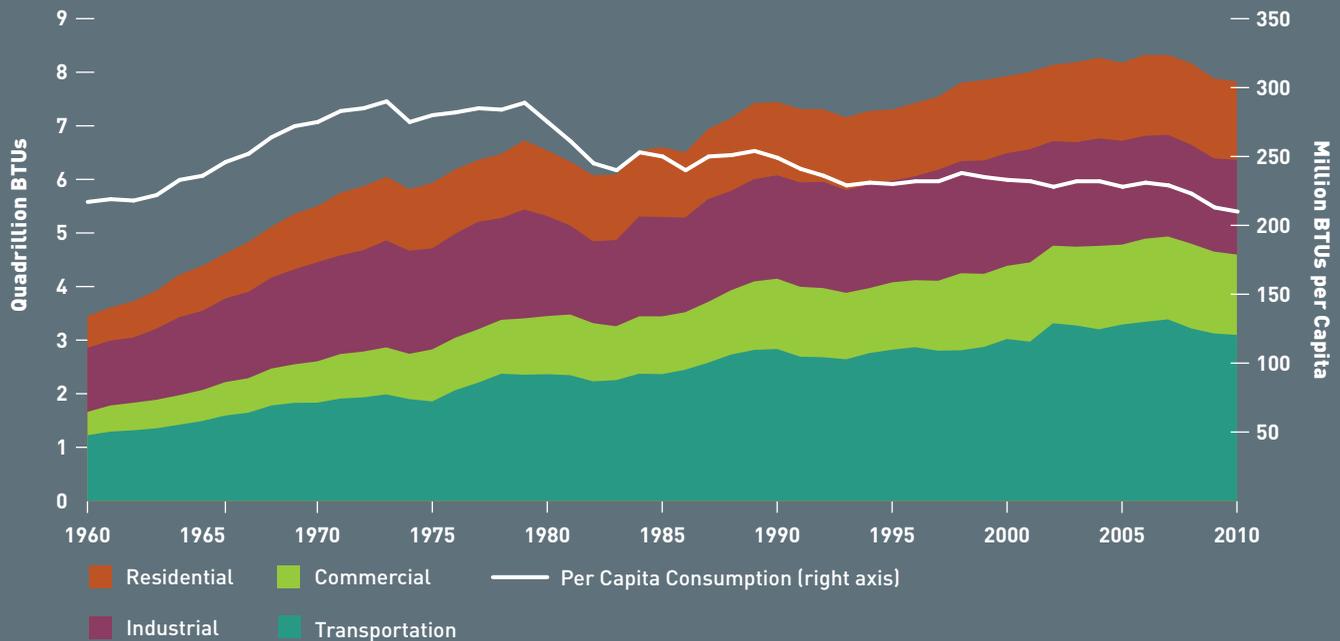
Meanwhile, many policies already underway are encouraging the state’s move away from petroleum. Abundant state and federal incentives support the purchase of alternative fuel vehicles and construction of related infrastructure. The air transport sector is investing in ways to improve its efficiency. Parking cash-out programs, which offer commuters a payment in lieu of subsidized parking, have been required for two decades, although they have not been steadily enforced. And California law already allows insurers to assess automobile premiums on a variable, per-mile basis rather than a fixed annual cost. Further supporting consumers’ transition to pay-as-you-drive policies could reduce statewide petroleum use by as much as eight percent while providing considerable savings for most Californians.

## INTENDED AUDIENCE



*Unraveling Ties to Petroleum* will be useful to a range of readers, from voters to state legislators and regulators to city councilmembers and planning commissioners.

**ES-1: CALIFORNIA ENERGY CONSUMPTION BY END-USE SECTOR**



Next 10 Unraveling Ties to Petroleum. Source: [U.S. Energy Information Administration, 2012]

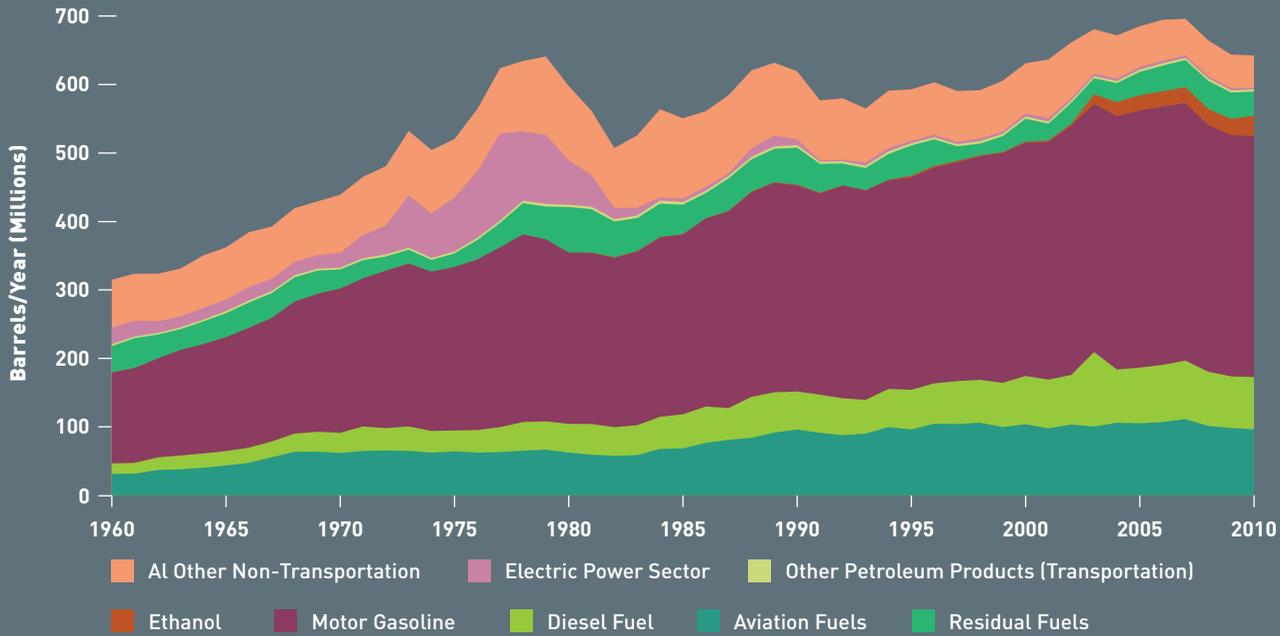
## ENERGY USE IN CALIFORNIA

In 2010, California represented roughly eight percent of U.S. and 1.5 percent of global energy demand. Within California, the transportation sector accounted for 39.6 percent of energy consumption, followed by the industrial sector (22.6%), commercial sector (19.2%), and residential sector (18.7%) (U.S. Energy Information Administration, 2012). Transportation has been California’s single largest energy consumer since the U.S. Energy Information Administration began tracking state-level data in 1960.

California energy comes from a range of fossil fuel and non-fossil fuel sources. Petroleum fulfills the greatest share (43.7%) of the state’s energy demand. Natural gas (29.3%), renewables (10.1%), and nuclear (4.2%) are other principal sources of energy generated within California. A significant amount (10.6%) of California’s energy supply comes from imported electricity.

**Understanding the connection between petroleum use and anthropogenic climate change provides an additional impetus to reduce California’s consumption of petroleum as an energy source.**

ES-2: PETROLEUM PRODUCT CONSUMPTION IN CALIFORNIA



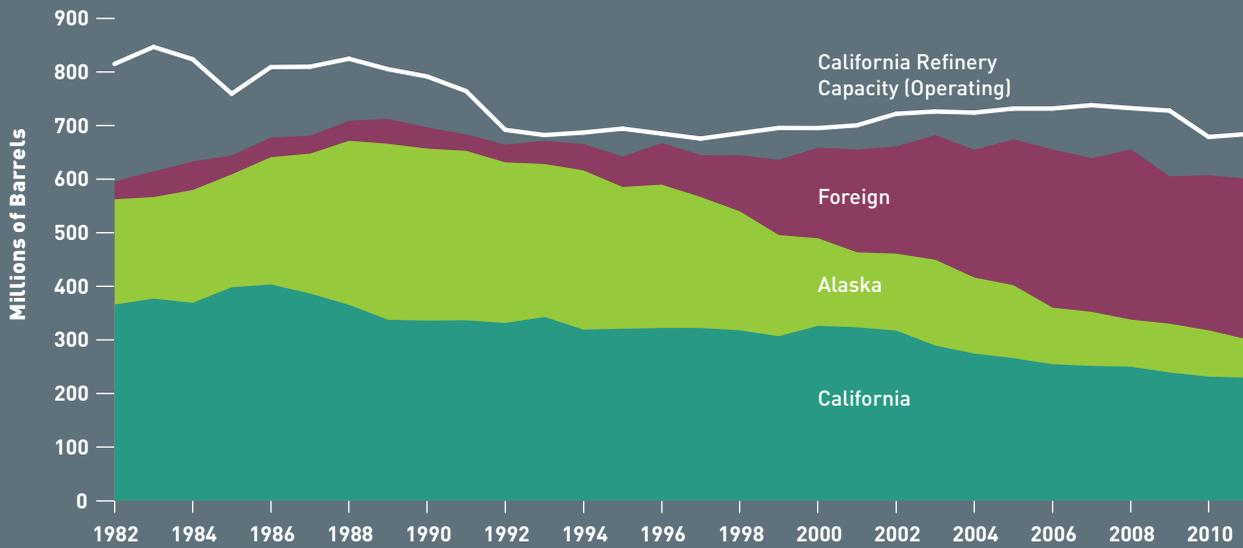
Next 10 Unraveling Ties to Petroleum. Source: (U.S. Energy Information Administration, 2012)

## PETROLEUM USE IN CALIFORNIA

California currently uses roughly 1.4 percent less petroleum than it did in 1979. However, the proportion of petroleum used for transportation has increased from 64.2 percent to 86.4 percent during that time. The industrial sector, which includes construction, accounts for most (11.2% of use across all sectors) of the non-transportation petroleum use in California, down from 18.2 percent in 1979. Motor gasoline makes up the bulk of petroleum consumption. Aviation fuels loaded in California, including aviation gasoline and jet fuel, follow. Bunker fuel, a heavier of residual fuel oil, is loaded at California ports for use in marine freight transportation. Asphalt and road oil are used primarily in construction, including for roofing materials and pavement. Other petroleum products, such as motor oil, make up an insignificant amount of California petroleum demand.

The proportion of petroleum used in transportation has increased largely due to the electric power and industrial sectors transitioning away from petroleum as an energy source. Oil price shocks beginning in 1974 and peaking in 1980 created a substantial incentive for large users to invest in alternatives. Use of petroleum by the state’s electric power

**ES-3: CALIFORNIA REFINERY CRUDE SOURCES AND OPERATING CAPACITY**

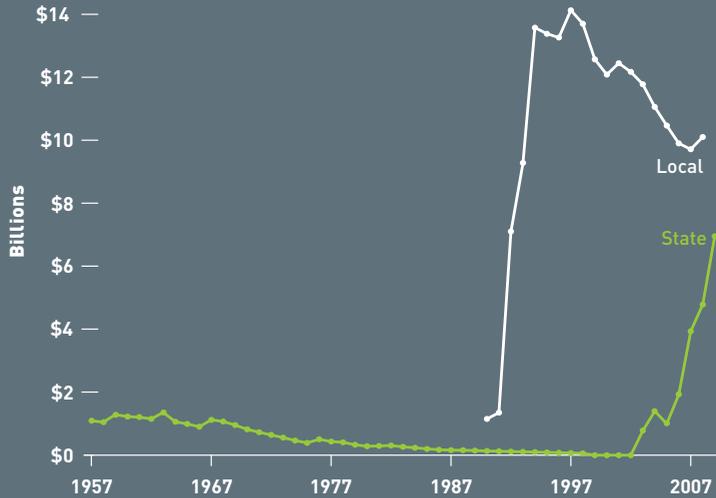


sector peaked at 19.9 percent in 1977. By 1984, less than one percent of California petroleum was used to generate in-state electricity. The Electric Power Sector now accounts for less than 0.4 percent of California petroleum demand. Industrial petroleum use as a proportion of statewide demand is down from 18.2 percent in 1979 to 11.2 percent in 2010.

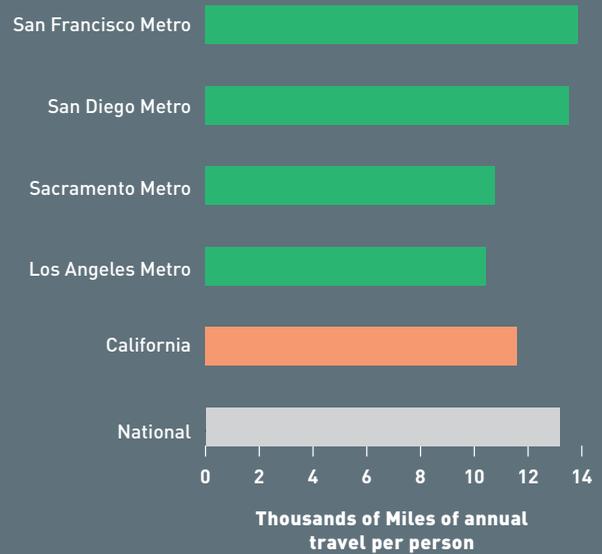
Californian and Alaskan oil production peaked in the mid-to-late 1980s. Since that time, the largest growth in petroleum receipts has been from foreign sources. Petroleum consumption in California has been in decline, as is the state's capacity to refine petroleum into finished products (see Figure ES-3).

Debt is an increasingly popular source of highway spending, growing substantially since 1990 (see Figure ES-4). This trend reflects stagnation in State and Federal taxes on gasoline, which remained unchanged since 1994.

**ES-4: CALIFORNIA STATE AND LOCAL HIGHWAY BONDS OUTSTANDING, END OF YEAR (adjusted for inflation)**



**ES-5: PER CAPITA MILES OF TRAVEL BY REGION IN CALIFORNIA**



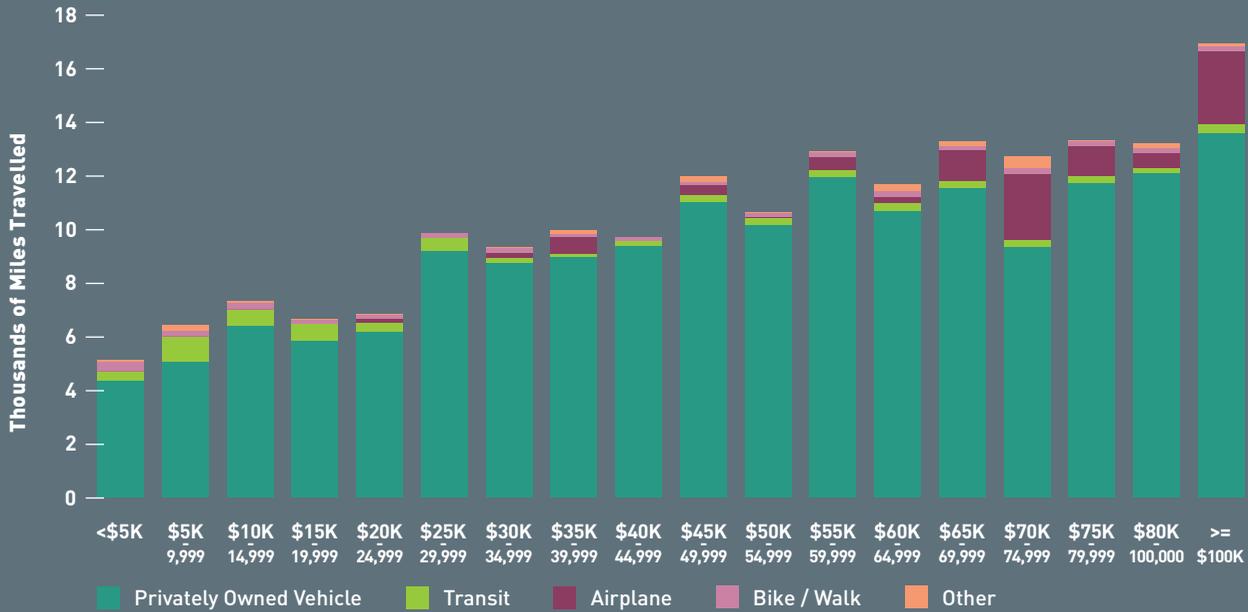
Next 10 Unraveling Ties to Petroleum. Source: (U.S. Federal Highway Administration, 2011) tables LGB-2 and SB-2 adjusted for inflation using Bureau of Economic Analysis state and local aggregate expenditures (2005=\$1.)

## REGIONAL AND STATEWIDE TRAVEL

Differences in travel among California’s major regions are largely a result of variations in a region’s area and incomes. Higher rates of air travel among Bay Area and San Diego residents means that, across all modes, residents of these areas travel greater distances in a year than the statewide average. Los Angeles and Sacramento area residents average fewer miles than the statewide average.

While Bay Area residents travel greater distances than the average Californian, they don’t drive more. Bay Area residents travel a greater proportion their annual distance on public transit (3.5% versus 2.5%) and airplanes (19.2% versus 8.3%) versus the statewide average. Thus, personal vehicle travel demand between the state’s two largest regions is more balanced, with most estimates showing greater per-capita vehicle distance traveled among Los Angeles area residents. Estimates vary in methodology and regional boundaries.

**ES-6: CALIFORNIA ANNUAL PER CAPITA MILES TRAVELED BY MODE AND HOUSEHOLD INCOME**

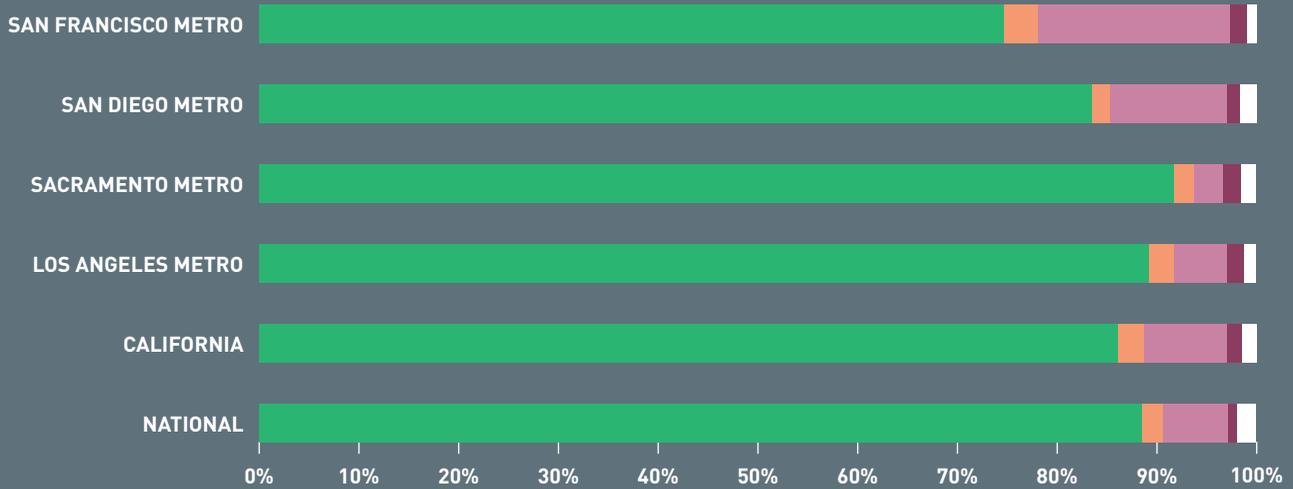


Next 10 Unraveling Ties to Petroleum. Source: (U.S. Federal Highway Administration, 2011) - 2009 National Household Travel Survey

Existing and planned measures to reduce petroleum use for transportation largely rely on technological substitution and increases in efficiency at the margins. The effects of such measures are likely to be inequitably distributed: leading to reductions in energy use but also in quality of life for some groups. An overreliance on vehicle fuel switching and efficiency versus alternatives to automobility can increase the burden for lower-income Californians. Nationally, the bottom 20 percent of households by income spend a significant share of their income (12.5%) on motor vehicle fuels.

**Between 1991 and 2011, the average per capita vehicle travel distance increased by only two percent. Much of the relative increase in transit use corresponds with increases in gasoline prices.**

**ES-7: PERCENT OF MILES TRAVELED BY MODE**



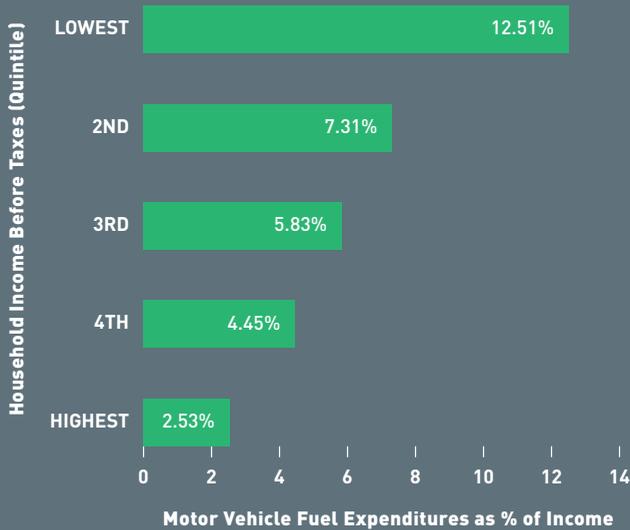
	National	California	Los Angeles Metro	Sacramento Metro	San Diego Metro	San Francisco Metro
<b>Privately-Owned Vehicle</b>	88.47%	86.09%	89.13%	91.70%	83.45%	74.60%
<b>Public Transit</b>	2.12%	2.53%	2.60%	1.94%	1.86%	3.46%
<b>Airplane</b>	6.45%	8.33%	5.26%	2.92%	11.72%	19.24%
<b>Walk / Bike</b>	0.99%	1.58%	1.71%	1.89%	1.28%	1.69%
<b>Other</b>	1.90%	1.43%	1.24%	1.49%	1.67%	0.99%

Next 10 Unraveling Ties to Petroleum. Source: (U.S. Federal Highway Administration, 2011) - 2009 National Household Travel Survey

Nationally, low-income households are far more likely to purchase used vehicles than are median and higher income households. Such purchasing behavior delays their access to new, alternative fuel and highly efficient vehicles which could mitigate their exposure to fuel price increases.

Volatile global energy markets, increases in California’s state excise tax, and the incorporation of transportation fuels within California’s cap and trade system can all increase this burden, signaling the need for robust alternatives to automobility in order to mitigate inequitable quality

**ES-8: 2011 MOTOR VEHICLE FUEL EXPENDITURES AS PERCENTAGE OF HOUSEHOLD INCOME, U.S.**



Next 10 Unraveling Ties to Petroleum. Source: (Bureau of Labor Statistics, 2012)

**ES-9: 2001-2011 VEHICLE PURCHASE EXPENDITURES BY INCOME QUINTILE, U.S.**



of life impacts related to California’s energy intentions.

Many Californians have already sought alternatives to personal vehicle travel. In 2010, the average Californian traveled about 15 percent more distance on transit than in 1990, down from 21 percent in 2009. Between 1991 and 2011, the average per capita vehicle travel distance increased by only two percent. Much of the relative increase in transit use corresponds with increases in gasoline prices.

The next few years will illuminate whether travel and energy trends observed during the Great Recession were part of a broader transition away from petroleum and automobility or largely the result of economic circumstance.

**ES-10: RELATIVE CHANGE IN CALIFORNIA DRIVING AND TRANSIT USE VERSUS REAL GASOLINE PRICES SINCE 1991**



Next 10 Unraveling Ties to Petroleum. Source: [U.S. Federal Highway Administration, 2011], [U.S. Federal Transit Administration, 2012], and [U.S. Energy Information Administration, 2012]

# 15 POLICY BRIEFS UNRAVELING PETROLEUM DEMAND FROM POLICY

The electric power sector’s transition away from petroleum took less than a decade. This transition resulted from a concerted effort to reduce the state’s exposure to global petroleum supply and price volatility. Transitioning the transportation system away from petroleum will be substantially lengthier and more complex.

Amidst this system complexity, we aim to highlight the implications of explicit and implicit planning and policy choices. We endeavor to bridge the gap between academic research and practice in order to create accessible, actionable information. We do so to provide new information and evaluative metrics for researchers, policymakers, and analysts at all jurisdictional levels. These assessments are not intended to be terminal tomes. Policymakers interested in implementation should seek additional information on how effects may vary based on their local conditions. Scholars prompted to new research opportunities will undoubtedly seek additional

information on their subjects. We developed a list of twenty-five policy factors we believe to have a direct or indirect effect on petroleum consumption in the state. After initial discussion with Next 10 and consideration of the potential value new information on each topic would have to the public and decision-makers, we narrowed this list down to a more manageable fifteen. We summarize each in order of how important we consider them to supporting California’s transition away from petroleum use. We developed a list of twenty-five policy factors we believe to have a direct or indirect effect on petroleum consumption in the state. After initial discussion with Next 10 and consideration of the potential value new information on each topic would have to the public and decision-makers, we narrowed this list down to a more manageable fifteen. We summarize each in order of how important we consider them to supporting California’s transition away from petroleum use.

Unlike the electric power sector—where decision-making is concentrated and generators and utilities are subject to strict, direct regulatory control, the transportation system is comprised of millions of loosely-regulated individual actors. Changing policies and implementing new measures to indirectly influence how California’s 35,209,430 registered motor vehicles travel will have uncertain outcomes. Government has

little direct control over these vehicles, other than through use of official traffic control devices and enforcement of the California Vehicle Code.

These assessments transcend the technical demands of California's transportation energy transition. Transportation requires dense, mobile energy storage – something that gasoline and diesel provide, but alternative fuels have struggled to match. The transition to electric propulsion makes energy storage and range a significant cost driver – a substantial departure from petroleum-based propulsion.

Moreover, travel is rarely an end in and of itself – but rather a means for an individual or group to access some economic or social opportunity – typically occurring at a fixed location. Thus, understanding the complex, integrated transportation and land use system – and the incentives it produces – is crucial to creating sustained changes that support policy goals. Each of the fifteen policy factors is described below.

## 1. CONVENTIONAL APPROACHES TO NON-RESIDENTIAL PARKING POLICY

Many cities are unwilling or unable to use market controls to manage a finite resource: on-street parking. Instead, they use minimum parking requirements in an attempt to manage scarcity and avoid the tragedy of the commons – spillover parking demand. Conventional parking approaches, which seek to predict and provide for peak parking demand in order to avoid parking spillover, greatly subsidize the true cost of driving and distort urban form.

Several alternatives to conventional parking policy exist. They include adaptive reuse of existing buildings without the need for additional parking, shared parking among many buildings in a district, in-lieu fees that fund alternative transportation and reduce the demand for parking, wayfinding to increase utilization of existing parking infrastructure, and the market-based allocation of parking spaces.

The transition away from conventional parking policy would occur gradually over the long-term, based on future changes to the built environment. Existing parking supply would likely remain. Changes in urban form would occur most rapidly in areas where current parking policy most constrains the built environment.

## 2. USE OF PERFORMANCE MEASURES THAT PRIORITIZE AUTOMOBILES OVER OTHER MODES IN CONGESTED AREAS

Most transportation departments in California use performance metrics that explicitly or implicitly ignore modes other than the automobile. The result is that many projects to expand the transportation network focus on adding automobile capacity at bottlenecks, rather than using alternatives to move additional persons. Because the scope of analysis excludes alternative modes, many transportation decisions impair the service quality of transit, walking, and biking. The implications are a profound effect on urban travel and motor vehicle fuel use.

Use of automobile-centric methods often leads a crowded bus to share equal weight with a single-occupant automobile. This leads the benefits of a bus-only lane – reduced delay for transit passengers and increased throughput through corridors – to be ignored. The method only considers delay for automobile drivers, a relic of such methods initial intent to proxy a driver's perception of roadway service quality. Thus, cost-benefit analyses often favor decisions that support drivers over passengers, leading to land use and transportation decisions that reinforce low-occupant vehicle use.

Local governments are largely free to transition to new methods on their own, provided that they amend their general plans to revise their transportation performance goals and prescribed methods for determining those goals. However, few understand the implications of current methods, and even fewer have made the transition. Transitioning to new methods to assess and optimize the performance of California's transportation network will lead to rapid increases transit, walking, and biking amenities.

## 3. BUNDLING OF RESIDENTIAL PARKING IN HIGH-QUALITY TRANSIT AREAS

On-street parking is perceived to be a scarce resource in many areas of California. Conventional parking policy, used by many California local governments to mitigate competition for on-street parking resulting from new development, prioritizes conflict avoidance over other goals – such as reducing vehicle trips. Changes in parking policy can make transportation alternatives attractive in areas where they are likely to be more robust. The state may be able to achieve substantial reductions in fuel use simply by separating the price of parking from the price of housing in areas where high quality transit exists.

Local governments can unilaterally employ unbundled park-

ing in high quality residential areas through changes to zoning codes. Alternatively, the State legislature can mandate this change – something policymakers have twice proposed. Such a policy change could have a high magnitude effect on petroleum use as the state’s four major regions expect 1.3 million new housing units in high quality transit areas over the next three decades.

## 4. AUTOMOBILE INSURANCE RATE STRUCTURE

Californians spend about half as much on automobile insurance premiums as they do on gasoline. A transition to per-mile insurance premium calculations would increase the variable cost of each mile driven and lead to lower premiums for a majority of drivers and lead to a significant reduction in driving per capita.

The State’s Department of Insurance now allows insurers to offer pay-as-you-drive programs. The transition could be a virtuous adoption cycle as low-mileage drivers shifting to per-mile plans triggers rate increases for drivers on annual plans. Faced with premium increases, more low-mileage drivers will switch to per-mile plans.

However, California faces two challenges in triggering this adoption cycle. First is consumer awareness. Second is a critical mass of per-mile policyholders in order for insurers to calculate per-mile actuarial risk, where early uncertainty may increase per-mile premiums. Early incentives may be necessary to induce early adoption of per-mile plans.

## 5. COMPENSATED AND REAL-TIME RIDESHARE BARRIERS

Sharing the ride is the elusive holy grail of options to reduce congestion and petroleum use. Each matched ride can take one vehicle off the road. However, sharing the ride is inherently more difficult than driving alone. Matching shared rides faces structural, communications, and incentive barriers that existing publicly-sponsored rideshare programs have addressed, but have yet to fully overcome.

Recent innovations in transportation service delivery can increase the utilization of existing transportation assets, including empty seats in private vehicles. New market entrants are in part responding to a structural shift in the market for automobility—a transition from reliance on privately-owned transportation assets to increased reliance on transportation as a service retained by the traveler. New private services directly address existing rideshare barriers,

but their potential to fully overcome them is still undetermined. The new services require the blessing of the California Public Utilities Commission, which as of spring 2013 is considering applicable regulations.

## 6. INFRASTRUCTURE AND COST BARRIERS TO ALTERNATIVE FUEL VEHICLE ADOPTION

Most federal, state, and local policies to promote alternative fuel vehicles attempt to influence consumer and firms’ vehicle purchase decision. These policies include financial subsidies for vehicle or equipment purchases, supply-side incentives for manufacturers of alternative fuel vehicles, and special privileges for users of alternative fuel vehicles.

The vehicle fleet replacement cycle limits the time frame over which policies to support alternative fuel vehicle acquisition will take effect. The California Air Resources Board estimates that a 50 percent of automobiles sold in California in 2011 will still be on the road in 13 years (California Air Resources Board, 2011). As alternative fuel vehicles currently make up a small percentage of new vehicle sales in California, achieving 50 percent or greater market share of alternative fuel vehicles is a long-term proposition.

Increasing the share of alternative fuel vehicles in the fleet will reduce consumption of petroleum, but increase consumption of energy from other sources. Switching to alternative fuel vehicles is unlikely to have a one-to-one effect on petroleum demand as petroleum is often used to process or distribute alternative fuels.

## 7. FUNDING PUBLIC INFRASTRUCTURE IMPROVEMENTS FOR NEW DEVELOPMENT

In post-Proposition 13 California, developers pay for much of the additional infrastructure required to support new development: schools, sewage systems, water delivery, and transportation improvements. While California law provides several options to finance public infrastructure improvements, most financing mechanisms are more applicable to greenfield development than to urban infill and brownfield development. The net result is likely a distortion of land use patterns that favors additional distance traveled.

State legislatures need not amend or repeal Proposition 13 to level the playing field. However, making the transition will likely require the reinstatement of tax-increment financing as an option for public infrastructure improvements required for infill development, particularly in high quality transit areas.

## 8. CARSHARE BARRIERS

Carshare is an emerging service category that fills existing gaps in travel choice for individuals and households seeking to shed or delay purchase of personal automobiles. Evolution in carshare service offerings will expand the market for the service by reducing the price and providing a greater range of options to meet consumer needs. Because carshare converts a fixed cost to a variable cost, it can reduce driving at the margins.

Carshare is currently available in California and there are few state-level regulatory barriers to its expansion. Local governments can support carshare by providing dedicated parking spaces for carshare services, either on-street, in public lots, or inside private development. Local governments must grant special parking privileges to attract point-to-point carshare services, which do not require dedicated spots and allow for one-way rentals.

## 9. LACK OF AWARENESS AND ENFORCEMENT AROUND PARKING CASH-OUT PROGRAMS

Existing California law requires many employers of more than 50 to offer employees a cash payment in lieu of any parking subsidy. Such a program allow employers to reduce the number of parking spaces they purchase or lease and gives employees an additional economic incentive to carpool, cycle, walk or use transit for their commute. Although the law is almost two decades old, a lack of information about which employers must offer cash-out impedes oversight and enforcement.

## 10. HIGH-OCCUPANCY VEHICLE NETWORK EXPANSION THROUGH LANE CONVERSION RATHER THAN NEW CONSTRUCTION

Policymakers expect HOV lanes to encourage rideshare by providing a benefit, time savings and reliability, to those in high occupancy vehicles. Nearly all HOV lanes implemented in California have been newly constructed rather than converted from existing general purpose lanes. Constructing rather than converting lanes delays the implementation and increases the expense of a complete HOV network. The result is the delayed effectiveness and lost opportunities to reduce petroleum use.

If California policymakers decided to permanently convert existing lanes to HOV lanes rather than constructing them

anew, the benefits of a completed metropolitan HOV network lanes would begin nearly instantaneously, reaching a steady state in the near term as individuals adjust their travel behavior. If transportation system users perceive a conversion as temporary, they may seek to wait out the change rather than adjust travel behavior.

## 11. BARRIERS TO IMPROVING EXPRESS BUS SERVICE

Allowing transit buses to use highway shoulders would lead to immediate efficiency benefits for express buses. Express bus ridership would increase in the mid-to-near term as more commuters are attracted to the service's reliable travel times. The Twin Cities region has a successful bus on shoulder program that is more than 20 years old. Attempts at pilot projects in California have not seen enduring success, but changes in state law could spur new trials.

Allowing transit buses the use of shoulders on controlled-access highways would affect only a small portion of transit route-miles in the state. Its effect on statewide motor vehicle fuel use would be similarly small. However, bus on shoulder treatments may be a viable option to improve the reliability of express and commuter bus transit service.

## 12. AVIATION PRACTICES AND PROCEDURES

Existing air traffic regulations and procedures are greatly limited by imprecise information about aircraft location and delayed command and control of aircraft. These limitations manifest in a multi-segment approach procedure that requires aircraft to level off at various stages. Continuous descent approach would allow aircraft to glide in for landing, reducing fuel consumed during the approach phase of flights.

## 13. DEDUCTIBILITY OF HOME MORTGAGE INTEREST AND STATE AND LOCAL REAL PROPERTY TAXES FROM TAXABLE INCOME

Though most scholars agree these interest deductions do little to affect home ownership rates, there is less agreement about their effects on land use. Some believe interest and property tax deductibility leads to larger lot size and larger houses. Others think they increase the price households are willing to pay for neighborhood amenities. Regardless of the land use impacts, the strongest effects are felt in California.

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Californians who itemize mortgage interest on their tax returns claim a higher value than in any other state, and growth limitations exacerbate any effects the deductions may have. California legislators can discontinue the home mortgage and local tax deduction from taxable income considered for state purposes. However, as federal income tax rates are higher than state rates, any effects on real estate markets would likely be muted without a federal legislative change.

## **14. LOCATION OF STATE ENTERPRISE ZONES**

California provides employer incentives to encourage employment in certain geographic areas of the state. If enterprise zones change the location of employment, they only do so slightly: firms that would have located near the enterprise zone locate within the enterprise zone instead. However, one State Enterprise Zone provision may slightly impact the distances employees travel to work. Employers are eligible for tax credits when they hire residents of targeted employment areas. Because this tax incentive is not restricted to a given enterprise zone's targeted employment areas, a potential result is additional distance by employees who travel between enterprise zone areas.

## **15. BARRIERS TO ENTRY FOR INFORMAL TRANSIT SERVICE**

California law requires informal transit operators to obtain a state or local license in order to operate. The licensing and insurance requirements serve as barriers to entry for informal transit services, such as jitneys, which frequently compete on cost. Reducing or eliminating regulatory barriers to jitney service would likely formalize existing, unlicensed operations in the state. However, increases in informal transit services would attract passengers otherwise served by existing shared transportation services or who are currently unserved, negating any petroleum-related benefits.

Brief Title and Relevant Topics	Magnitude (estimated effect on fuel use from decision to address factor)	Certainty	Primary Effect on Fuel Use	Secondary Effect on Fuel Use	Applicable Level of Government	Time-Horizon for Implementation and Effectiveness
<b>1. Conventional Approaches to Non-residential Parking Policy</b> parking, zoning, urban form	High (5.7% to 24.9% reduction)	Medium	Distance Traveled	Mode Choice and System Operations Efficiency	Local	Long-Term
<b>2. Use of Performance Measures that Prioritize Automobiles over Other Modes in Congested Areas</b> level of service, traffic congestion, transit priority, roadway expansion	High (3% to 15% reduction)	Medium	Improved System Operations Efficiency with offsetting increase in Distance Traveled	Mode Choice	Local	Near-Term
<b>3. Bundling of Residential Parking in High-Quality Transit Areas</b> parking, transit, housing	High (3% to 7% reduction)	Medium-High	Mode Choice	Distance Traveled	State, Local	Near-Term
<b>4. Automobile Insurance Rate Structure</b> automobile insurance, marginal cost of driving	High (8% reduction)	High	Distance Traveled	System Operations Efficiency	State	Medium-Term
<b>5. Compensated and Real-time Rideshare Barriers</b> rideshare, taxi, e-rideshare	High (0.04% increase to 18.35% reduction)	Medium	Vehicle Miles Traveled	Mode Choice	Local, State, Federal	Near-Term
<b>6. Infrastructure and cost barriers to Alternative Fuel Vehicle Adoption</b> electric vehicles, hydrogen vehicles, natural gas vehicles, incentives, tax expenditures	High (not evaluated, approved policy in process)	High	Fuel Composition		Federal, State, Local	Near-Term
<b>7. Funding Public Infrastructure Improvements for New Development</b> municipal finance, impact fees, infrastructure finance	Medium-High (2% to 5% reduction)	Low-Medium	Distance Traveled		Local, State	Near-Term
<b>8. Carshare Barriers</b> automobile ownership, transportation services, technology	Medium (0.05% to 7% reduction)	Medium	Mode Choice	Distance Traveled	State, Local, Federal	Near-Term

Brief Title and Relevant Topics	Magnitude (estimated effect on fuel use from decision to address factor)	Certainty	Primary Effect on Fuel Use	Secondary Effect on Fuel Use	Applicable Level of Government	Time-Horizon for Implementation and Effectiveness
<b>9. Lack of awareness and Enforcement around Parking Cash-out Programs</b>	Low-Medium (0.6% to 2.5% reduction)	High	Mode Choice		State, Air District, Local	Near-Term
<b>10. High-Occupancy Vehicle Network Expansion through Lane Conversion rather than New Construction</b> carpool, rideshare, transportation network expansion, incentives	Low-Medium (0.1% to 0.5% reduction)	Medium	Mode Choice	System Operation Efficiency	County, Regional, State, Federal	Near-Term
<b>11. Barriers to Improving Express Bus Service</b> transit, controlled-access highway	Low (0.004% to 0.063% reduction)	Medium-High	Mode Choice		State	Near-Term
<b>12. Aviation Practices and Procedures</b> aviation, next generation air transportation system	Low-Medium (for aviation) (1% to 3% reduction in aviation fuel use)	Medium-High	System Operation Efficiency		Federal	Near-Term
<b>13. Deductibility of Home Mortgage Interest and State and Local Real Property Taxes from Taxable Income</b> mortgage, income tax, deduction, financial incentives, tax expenditures, home ownership, housing	Low-Medium (0.1% to 2.6% reduction)	Low-Medium	Distance Traveled	Other-building energy demand	Federal, State	Near-Term
<b>14. Location of State Enterprise Zones</b> tax expenditures, economic development, employment	Low (0 to 0.1% reduction)	Medium	Distance Traveled		State, Local	Near-Term
<b>15. Reducing Barriers to Entry for Informal Transit Service</b> jitneys, dollar vans, entrepreneurship in mass transportation	Low (0 to 0.15% reduction)	Medium-High	Mode Choice		State, Local	Near-Term

## ABOUT

### THE AUTHORS

As Director of the UCLA Local Climate Initiative, **Juan Matute** researches performance measurement in transportation and land use systems and non-linear change in dynamic, complex urban systems. As a Lecturer in Environmental Science at UCLA, Juan teaches a systems-based approach to local climate planning and policymaking. He co-authored a chapter in the Oxford Handbook of Urban Planning that explains the role of multi-level governance and accounting frameworks in climate planning.

Juan seeks to translate academic research into a form useful to those charged with managing California's transition to a low-carbon economy. He has advised several local government greenhouse gas inventories and climate action plans in California – he wrote the method that most now use to estimate greenhouse gas emissions from passenger vehicles. He managed UCLA's work on California's Statewide Transit Strategic Plan and created TransitWiki.org, a best-practices sharing website for transit practitioners. He is a member of the American Institute of Certified Planners.

**Stephanie Pincetl** is Adjunct Professor and Director of the California Center for Sustainable Communities at UCLA. Dr. Pincetl conducts research on environmental policies and governance and analyzes how institutional rules construct how natural resources and energy are used to support human activities. She is an expert in bringing together interdisciplinary teams of researchers across the biophysical and engineering sciences with the social sciences to address problems of complex urban systems and environmental management.

She has received funding from the California Energy Commission PIER program to develop a methodology to understand energy use in communities in California using urban metabolism methods coupled with social policy considerations. Her book, *Transforming California, the Political History of Land Use in the State*, is the definitive work on land use politics and policies of California. Dr. Pincetl is the Faculty Director of the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC), a Los Angeles regional organization dedicated to working across jurisdictions to achieve a better future.

## THE ORGANIZATIONS

**Next 10** is focused on innovation and the intersection between the economy, the environment, and quality of life issues for all Californians. Next 10 creates tools and provides nonpartisan information that fosters a deeper understanding of the critical issues affecting all Californians. Through education and civic engagement, we hope Californians will become empowered to affect change.

Next 10 was founded and is funded by venture capitalist and philanthropist F. Noel Perry.

**The California Center for Sustainable Communities (CCSC)** is a statewide University of California collaboration, funded and supported by the Public Interest Energy Research Program of the state Energy Commission. The Center conducts work on topics important to the transition toward greater urban sustainability, bringing together the leading edge researchers and centers from across several campuses. CCSC provides research, insights, data, methods, models, case studies, tools and strategies to address land use and transportation challenges facing California communities, and serves as a resource for policy makers, stakeholders and the residents of the state. Our mission is to assist the state's communities in the transition to greater sustainability on multiple fronts.

The Center is housed at UCLA and is a collaboration between the UC Berkeley's Center for Resource Efficient Communities, UC Davis Extension's Land Use and Natural Resources Program, UC Davis' Plug-in Hybrid and Electric Vehicle Center, UC Davis' Center for Regional Change, and UCLA's Institute of the Environment and Sustainability.

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DESIGNED BY JOSÉ FERNANDEZ