Cap & Share for VMT in California

Mike Sandler
msandler1@ucla.edu
December 3, 2008
Transportation and Land Use Case Study

Summary: *Vehicle miles traveled (VMT) by California residents has increased by more than 3 percent a year between 1975 and 2004. During that period the state's population growth rate was less than 2 percent. If VMT continues to grow at 3 percent, as Caltrans and others predict, it would overwhelm the efficiency measures taken to reduce greenhouse gas emissions from the transportation sector. This case study discusses capping VMT in California at 2005 levels, and distributing a "Share" of the VMT under the cap to residents on an equal per capita basis. The Share could take the form of a debit card, transponder, or FastTrak account. Cap & Share for VMT would reward those who drive less than their allocation with cash or transit passes, while those who exceed their VMT allocation must buy Shares from others.*

Outline

I. Introduction

Vehicle miles traveled (VMT) is a measure used to describe automobile use that incorporates the number of vehicle trips, traffic volume, and the length of those trips.[1] VMT is growing in California, and contributing to the state's greenhouse gas emissions. The State's attempts to address climate change will have a better chance of success if VMT is held level or even reduced. This case study applies a "Cap and Share" approach to VMT, by capping regional VMT at 2005 levels and allocating a tradable portion of the cap to each driver. This equal per capita "Share" of the VMT under the cap could take the form of a debit card, transponder, or FastTrak account. When coupled with tolls, VMT Cap & Share rewards those who stay under their allocation with cash or transit passes, while those who exceed their VMT allocation pay a fee. In assessing this concept, I focus on issues of equity that may arise if this program were implemented in California.

A. GHGs, Transportation, and VMT

The Intergovernmental Panel on Climate Change has determined that climate change is accelerating due to the accumulation of greenhouse gases (GHG), primarily carbon dioxide (CO2), in the atmosphere, as a result of from the burning of fossil fuels, deforestation, and other human activities. Climate scientists believe that industrialized nations must cut emissions by 80 percent from today's levels to stabilize the amount of carbon dioxide in the atmosphere and prevent the most severe impacts of climate change.

Transportation is the second largest source of the nation's greenhouse gas emissions. In 2006 electricity generation accounted for 34 percent of national greenhouse gas emissions, and transportation accounted for 28 percent.[2] The EPA's GHG Emissions Inventory for the US showed that in the 1990s GHGs from mobile sources increased 18%, primarily from VMT. In California, which has less coal in its electricity mix, the transportation sector is the largest source of emissions. Transportation was responsible for 38% of California's GHG emissions in 2004, while electric power emissions account for 25%.[3] The transportation sector is responsible for an even larger share of emissions in some localities including Northern California, where coal only represents 3% of PG&E's electricity. Transportation accounted for 58% of Marin County's total greenhouse gas emissions in 2000, 42% of Sonoma County's 2000 total emissions, and 48.6% of 2006 emissions in the nine county Bay Area.[4] A source inventory conducted by the Bay Area Air Quality Management District found that the transportation sector contributed 50.6% of the Bay Area's 2002 GHG emissions.[5]

---

[1] Although "miles" is plural, "VMT" is singular, since it is a single numerical indicator composed of miles traveled.
[2] US EPA. " Inventory of US Greenhouse Gas Emissions and Sinks 1990-2006" USEPA #430-R-08-005 April 2008. http://www.epa.gov/climatechange/emissions/downloads/08_Trends.pdf
[3] http://www.arb.ca.gov/cc/inventory/data/graph/graph.htm
[4] Erickson, Dave and Ann Hancock. "Climate Protection in Sonoma County," and "Climate Protection in the San Francisco Bay Area" July 2006 and September 2007. www.climateprotectioncampaign.org
[5] Bay Area Air Quality Management District. "Source Inventory of Bay Area Greenhouse Gas Emissions" November 2006. http://www.baaqmd.gov/pln/ghg_emission_inventory.pdf

With the passage of AB32, the Global Warming Solutions Act of 2006, California enacted a mandatory emissions cap that requires the state to reduce its GHG emissions to 1990 levels by 2020. The California Air Resources Board (ARB) calculates that state emissions in 1990 emissions were 433 MMTCO2E. By 2004 they had grown to 484 MMTCO2E, and the Business as Usual (BAU) scenario projected 596 MMTCO2E. To meet the 2020 goal, we need only a reduction of 51 MMTCO2E from 2004 levels, but taking into account projected growth in California's population and economy, meeting the 2020 goal would require a reduction of 163 MMTCO2E. The AB32 Draft Scoping Plan released by the ARB estimates the State can achieve a reduction to 422 MMTCO2E by 2020.[6]

Greenhouse gas emissions (GHG) from the transportation sector arise from the combustion of fossil fuels, which is a result of the number of drivers (population), the number of vehicles, the vehicle miles traveled (VMT), fuel efficiency of the vehicle fleet, and more. In addition to reducing VMT, policies that reduce greenhouse gas emissions from the transportation sector can focus on vehicle technologies (for example, raising CAFE standards for fuel efficiency), low-carbon fuels, and vehicle/system operations. This paper focuses on VMT reductions. Factors that affect VMT include trip rate, trip length, mode share, and more.[7]

B. The potential for VMT growth to overwhelm efficiency measures

Over the past 30 years, VMT has been growing. According to National Household Travel survey series data and federal VMT databases, since 1977, total person VMT for daily travel grew by 151 percent, and overall VMT has grown by over 90 percent.[8] The US population grew by approximately 30 percent during that time. If population growth accounted for 30 percent of personal VMT growth, the remaining VMT growth may be attributed to factors including population age profile, auto availability, licensure rates, household size, shared ride propensity, transit use propensity, walk propensity, male and female labor force participation, real income per capita, and land use patterns.

In California, vehicle miles traveled (VMT) by California residents has increased by more than 3 percent a year between 1975 and 2004. During that period the state's population growth rate was less than 2 percent. California's population is predicted to

[6] California Air Resources Control Board. AB32 Proposed Scoping Plan. October 2008. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

[7] Schaper, Vincent and Philip Patterson. "Factors that Affect VMT growth." Office of Transportation Technologies. U.S. Department of Energy. Washington, D.C. 1998.

[8] Polzin, Steven E. "The Case For Moderate Growth in Vehicle Miles of Travel: A Critical Juncture in U.S. Travel Behavior Trends" Center for Urban Transportation Research, University of South Florida prepared for U.S. Department of Transportation, April 2006. http://www.cutr.usf.edu/pdf/The%20Case%20for%20Moderate%20Growth%20in%20VMT-%202006%20Final.pdf

increase by 24 million people by 2050, an increase of 40 percent.[9] Los Angeles County is projected to grow from 9.6 million to 13 million by 2050, an increase of 27 percent. If statewide VMT continues to grow at 3 percent per year, as Caltrans and others predict, it would overwhelm the efficiency measures taken to reduce greenhouse gas emissions from the transportation sector.[10] The State has recognized this problem, and has included dozens of transportation measures into its AB32 Scoping Plan, as well as passing a law in October 2008, SB 375, requiring state consultation with metropolitan planning organizations (MPOs) to develop passenger vehicle greenhouse gas emissions reduction targets for 2020 and 2035 by September 30, 2010.

II. Policies for pricing transportation

A. Congestion pricing, pricing parking, gas tax, and cap and trade

Access to most roadways is free, and gasoline is cheap compared to its social costs. In addition to regulations to reduce negative social impacts from transportation, creating prices for aspects of transportation can help internalize transportation costs such as congestion and pollution, provide an incentive to change driving behavior, and help raise funds to pay for transportation projects. Four potential policies that address transportation "externalities" through pricing are congestion pricing, pricing parking, a gas tax, and cap and trade.[11]

Congestion pricing introduces charges equal in theory to marginal costs of driving at peak travel times. Through the use of High Occupancy Toll (HOT) lanes such as Highway 91 or cordoned areas in downtowns such as London, congestion fees provide economic incentives that can make more efficient use of limited road capacity. Moore et al describes a congestion pricing demonstration project conducted by the Puget Sound Regional Council in the Seattle region in 2005. The project used an electronic vehicle positioning system that debited accounts when 500 volunteers drove in congested areas at congested times (Moore pg. 98).

Professor Donald Shoup and others have shown that parking charges can reduce trips. Moore et al notes that parking charges may not necessarily reduce VMT (pg. 107).

Gas taxes are a major source of funding for transportation projects. Taxing gasoline use follows the "polluter pays" and "user pays" principles, since drivers who pay the tax are the ones who emit pollution and use the roads. However, declining gas tax revenues are causing a fiscal crisis in transportation project funding. California's state gas tax of 18 cents per gallon went into effect in 1994. According to the Legislative Analyst's Office,

---

[9] California Department of Finance. Press Release, July 7, 2007. http://www.dof.ca.gov/html/DEMOGRAP/ReportsPapers/Projections/P1/documents/P1_Press_Release_7-07.pdf

[10] Bartholomy, Panama, Gerry Bemis, Gina Barkalow, Nancy McKeever, Suzanne Phinney, Julia Silvas, and Joanne Vinton. "The Role of Land Use in Meeting California's Energy and Climate Change Goals." California Energy Commission. CEC-600-2007-008-SR. August 2007.

[11] Moore, Terry, Paul Thornes, and Bruce Appleyard. *The Transportation/Land Use Connection*, APA, 2007.

VMT on California's roads increased by 28% between 1991 and 2007, but since gas tax revenues (adjusted for inflation) have not increased, reducing the revenue generated per mile traveled by more than 20 percent. Inflation has caused the value of per gallon tax revenues to erode by 29 percent.[12] The LAO report recommends considering mileage-based fees to augment declining gas tax revenues. The report states, "Mileage-based fees and tolls offer an advantage over gas taxes in that these revenues are not eroded by increasing fuel economy or alternative fuel usage."

Moore et al describes a combination gas tax and emissions tax that varies by location according to factors including congestion (pg. 109). Transponders along congested corridors record a car's movements and log the congestion fees drivers pay onto each car's electronic receiver.

Planners and economists such as Moore advocate for raising gas taxes, but outside those professions, it is politically unpopular. Some skeptics of gas taxes (and carbon taxes) to change driving behavior point out that the demand for gasoline has been relatively price-inelastic, saying that prices can go up and demand will barely change. Charles Komanoff of the Carbon Tax Center analyzed increases from 2005 to 2008 in the price of oil, and states that demand for gasoline is not totally inelastic.[13] Skeptics of gas taxes also note that, gas taxes, like sales taxes, have a regressive impact on lower income families. Bento et al (2005) simulates returning gas tax revenues to households as a method to reduce regressivity. They model two revenue recycling methods. Income-based revenue recycling returns gas tax revenues to households in proportion to their benchmark income, and is found to be highly regressive. Tax-based recycling, in which revenues are recycled to households in proportion to their gasoline-tax payments, makes the gas tax increase proportional in its impact on households across incomes.[14]

A gas tax sets a fixed price, but allows the quantity of priced product (in this case the amount of gas) to move up and down with supply and demand. A cap and trade (or "capped") system, on the other hand, restricts the quantity of the product by setting a cap, and lets the price (of a permit representing a portion of the cap) fluctuate with supply and demand. One of the theoretical benefits of a cap and trade system is that market players from sectors where the costs of emission reduction is high can purchase permits from sectors where costs are low, increasing the overall efficiency of reductions. The most well known cap and trade system was the U.S. Acid Rain Program, established by the 1990 Clean Air Act Amendments, which helped reduce the amount of sulphur dioxide

[12] Legislative Analyst's Office, "Funding for Transportation Programs: Issues and Challenges," April 2, 2008. http://www.lao.ca.gov/handouts/transportation/2008/Transportation_funding_issues_04_02_08.pdf
[13] Komanoff, Charles. "We Explain Gasoline Demand (including why it's sticky)" Carbon Tax Center Blog. 05/12/2008 http://www.carbontax.org/blogarchives/2008/05/12/we-explain-gasoline-demand-including-why-its-sticky/
[14] Bento, Antonio M., Lawrence H. Goulder, Emeric Henry, Mark R. Jacobsen and Roger H. von Haefen. "Distributional and Efficiency Impacts of Gasoline Taxes: An Econometrically Based Multi-Market Study" *The American Economic Review*, Vol. 95, No. 2, Papers and Proceedings of the One Hundred Seventeenth Annual Meeting of the American Economic Association, Philadelphia, PA, January 7-9, 2005 (May, 2005), pp. 282-287

(SO2) and nitrous oxides (NOX) from power plants.[15] Proponents of cap and trade systems believe that a limit on emissions creates a carbon price, which incentivizes market players to find the most cost-effective means of complying with the cap. Since the late 1990's, policymakers have attempted to apply cap and trade concepts to CO2 reduction, notably through the Kyoto Protocol and the European Emissions Trading System. At the same time, experts disagree on specific design elements of cap and trade systems such as how to allocate allowances, and whether a trading system that worked for power plant-specific pollutants like SOX and NOX is appropriate for a ubiquitous pollutant like CO2.[16]

B. A CO2 price signal and the transportation sector

The transportation sector differs from the electricity sector in that, while only a few hundred electricity generators burn the fossil fuels that cause emissions, transportation fuels are combusted by millions of tailpipes. The point of combustion for electricity generators is described as "upstream" as opposed to the "downstream" tailpipes.

Green et al (2007) compares the CO2 emissions intensity per energy unit of coal versus gasoline. They find that because coal has an emissions intensity of 1.903 Mt/Energy unit, while gasoline has an emissions intensity of only 0.009 Mt/Energy unit, a $15/ton CO2 tax would raise the price of coal by $28.55/energy unit, but the price of gasoline would rise by only 14 cents per energy unit.[17] One conclusion from this is that the price signal would be more muted for gasoline than for coal. Therefore, emission reductions due to behavior change as a result of a price signal would occur for electricity before transportation. It would take a much higher carbon price for the transportation sector to provoke an equivalent level of behavior that a lower carbon price provokes in the electricity sector.

The argument that a pricing system such as cap and trade is not an effective method to reduce emissions in from the transportation sector is supported by the following three contentions: 1) the low carbon emissions intensity of gasoline makes the carbon price more dispersed than for coal, 2) the downstream point of combustion in the transportation sector means the already dispersed price signal could affect millions of drivers, not just a few hundred power plants, and 3) the political unpopularity of gas taxes could lead to a backlash that would overturn the policies. Moore et al describes the costs of doing nothing as "congestion as rationing" (pg 180). As an example, if Yosemite becomes too

---

[15] US EPA. Clean Air Markets and Cap and Trade webpage. http://www.epa.gov/airmarkt/cap-trade/index.html

[16] SRU German Advisory Council on the Environment. "National Implementation of the EU Emissions Trading Scheme: Market-based climate change mitigation or the continuation of energy subsidies by other means?" April 2006. http://www.umweltrat.de
Matthes, Felix, Verena Graichen, and Julia Repenning. "The environmental effectiveness and economic efficiency of the European Union Emissions Trading Scheme: Structural aspects of allocation," A report to WWF by Öko-Institut. November 2005.

[17] Green, Kenneth, Steven F. Hayward, Kevin A. Hassett "Climate Change: Caps vs. Taxes" Environmental Policy Outlook, AEI Online, June 1, 2007.
http://www.aei.org/publications/filter.all,pubID.26286/pub_detail.asp

congested with people, demand will decline. Doing nothing is politically simple, yet inefficient use of the resource, and the social costs are high.

The next section introduces a concept that addresses those arguments by proposing a system that sets up a cap for VMT separate from the economy-wide cap for other sectors such as electricity. Tradable shares of VMT under the cap are distributed to drivers, allowing drivers who drive less than average to profit from the system, which could reduce the political opposition to the cap.

III. Cap & Share

A. Background

The Cap & Share concept has been promoted since 2006 by a non-profit organization based in Ireland and the UK called FEASTA-The Foundation for the Economics of Sustainability.[18] Cap & Share was originally developed as a method to distribute shares of an economy-wide cap on greenhouse gas emissions (GHG) to citizens on an equal per capita basis. The point of regulation is upstream, and fossil fuel producers and importers are required to purchase the shares from people. As people sell their shares to the upstream companies, the companies raise fuel prices, but return the "scarcity rent" of the permits back to households As the overall cap declines, the shares gain in value. Households that use more fuel than average will end up spending the value back to fuel companies, while households that use less fuel may come out ahead at the end of the year.

A similar program is being discussed to address over fishing of depleted fisheries. The "Catch-Share" program described on the Environmental Defense Fund website sets a cap on the fishery's Total Allowable Catch. Then it distributes "individual fishing quotas" to each fisherman, community or fishery association. The Pacific Fishery Management Council plans to institute a "Catch-Share" program in order to encourage cooperation, rather than competition, among fishermen working the cod, whiting, rockfish, flounder and sole fisheries from Morro Bay on California's Central Coast to Puget Sound in Washington state.[19]

B. Cap & Share for VMT in California

How could the Cap & Share concept be applied to VMT on State Highways in California? This section describes a program that caps (household/non-commercial)[20]

---

[18] FEASTA's website is http://www.feasta.org. The Cap & Share website is www.capandshare.org. The author maintains a website describing a similar concept called Carbon Share at www.carbonshare.org.

[19] Christopher Costello, Steven D. Gaines, and John Lynham "Can Catch Shares Prevent Fisheries Collapse?" Science Vol. 321. no. 5896, pp. 1678 - 1681 (19 September 2008)
Weiss, Kenneth R. "Major change planned for West Coast fisheries" LA Times, November 10, 2008 http://www.latimes.com/news/science/environment/la-me-fish10-2008nov10,0,3402253.story
and Environmental Defense Fund Website. http://www.edf.org/page.cfm?tagID=69

[20] A separate program could be developed to address the issues and actors involved in commercial goods movement, but that is not the subject of this paper.

VMT in California at 2005 levels, and distributes certificates representing an equal portion of VMT to households.[21] In this program, a per capita VMT allocation is distributed and may be traded. People who drive less than average could sell their share to those who exceeded the average amount of miles. The goal of the program is to reduce VMT by adding a nominal fee to additional miles traveled above a regional average. The program would only apply to the household, non-commercial miles traveled.

The use of electronic disbursement, crediting and debiting of VMT from accounts, and trading could reduce the transaction costs of the program. The Shares would be distributed electronically to a transponder, which could take the form of a debit card connected to a FastTrak receiver. The transponder should be registered with a driver, rather than a vehicle. If the transponder were attached to a vehicle, wealthy people could try to game the system by purchasing multiple vehicles in order to increase their VMT allocation. A transponder that follows individuals, or allows for group accounts for a household, would prevent wealthier drivers with multiple vehicles from obtaining a larger VMT allocation. The transponder should be registered with a driver, rather than be attached to a vehicle.

C. California County VMT Data

VMT data can help estimate how many miles each Share would represent. The average VMT per capita by California County in 2005 was 5,053. Rural counties, especially in the sparsely populated Sierra Nevada mountains, had much higher per capita VMT than the densely populated metropolitan areas. The ten counties with the highest VMT per capita had an average population of just 23,000 people, while the ten counties with the lowest VMT per capita included populous Los Angeles, Orange, Santa Clara, and Sacramento Counties.[22]

The average VMT in the San Francisco Bay Area was 5,407. But within the region, Solano County's per capita VMT was over 8,000, while San Francisco's was only 1,752 (the lowest in California). The average per capita VMT for Los Angeles, Riverside, and Orange counties was 4,858, with Los Angeles on the low end with 4,034, and Riverside with 5,861.

Illustration B contains a chart of the ten counties with the highest per capita VMT and the ten counties with the lowest per capita VMT (the break is between Modoc and Santa Clara Counties), shows that total VMT in 2005 tracked closely with population.

The data shows that drivers in Sierra Nevada counties require a larger amount of VMT in their annual allocation than drivers in more urban counties. Metropolitan counties could

[21] Moore et al describes a similar "tradable permits" concept, where the government distributes a chosen number of trips, allows the permits to be transferable, sets up an online market (including Ebay), and revenues generated by the sale of permits goes to those to whom the permits were initially allocated rather than to the transportation authority (pg. 177).

[22] CalTrans Traffic Data Branch. VMT on State Highways by County. http://traffic-counts.dot.ca.gov/monthly/histdatacounty.xls See Illustration A at the end of this paper.

use a regional allocation to account for the driving between counties (such as in the San Francisco Bay Area), while rural counties could use county-specific allocations. If drivers in rural counties with larger per capita allocations were allowed to trade with drivers in urban counties, a few households that do not drive would have large VMT surpluses. From a global warming perspective, it does not matter where the VMT (and therefore emissions) are reduced, but from an air pollution and public health perspective it does. There could also be resentment between urban counties who might have to purchase VMT and rural counties. Therefore, if allocations differ, it may be prudent to limit trading to drivers residing in the same county.

D. Policy questions: Congestion, density, and regressivity

A VMT Cap could have various impacts on congestion. It could potentially magnify congestion if drivers try to minimize their mileage by taking more direct routes, which may be more congested. The share's denomination in VMT does not discourage drivers from highly impacted roadways. On the other hand, if some drivers decide to sell their share instead of use it (and carpool or take transit instead), it could take some cars off the road. The VMT limit's effect on congestion would depend on 1) whether the value of the permit changes at peak hours or not, and 2) whether other policies such as congestion pricing or tolls on certain roadways were adopted in combination with the VMT Cap & Share. Congestion pricing or other tolls could be adopted as complementary policies.

A VMT Cap's impact on land use could benefit landlords and disadvantage renters. If the VMT Cap and Share system adds to transportation costs, it could encourage denser land use and add value to housing near employment and mixed-use centers. Developers might factor the cost of the share into their expected rents, assuming that people who live in transit-oriented developments would drive less and be able to sell at least a portion of their shares. In that case, the "rents" from the Share would be passed along to landlords. These rents would act as a financial incentive to developers would encourage denser land uses, which also helps reduce VMT and accomplishes the goal of the program. Even in rural counties, where the average VMT per capita is much higher than in urban counties, driver demand for shorter trips could lead to siting mixed uses closer to each other.

A VMT cap would have mixed effects on low-income households, depending on several factors, including the number of drivers in the household, the number of vehicles, and their location. Some low-income workers have longer commutes and less flexibility in their housing location and job choice than higher income workers. On the other hand, in some areas high-income households have chosen to live in exurbs away from employment centers, and could afford to pay for the additional social costs of those choices. Some high-income workers may have more options to reduce their VMT, for example, by telecommuting. The increase in rents near employment and mixed-use centers would also disadvantage low-income households. On the plus side, low-income households that used more transit, alternative modes, and drove less could sell part of their excess VMT Share, and income from the Share would benefit low-income households more as a fraction of their income. In summary, households with high VMT

across income groups would bear the most costs under a VMT cap, and the distribution of VMT.

E. Conclusion

California may not be able to address climate change unless it stops VMT from increasing. A VMT Cap & Share program would provide a method to indirectly encourage reductions in vehicle trips and/or trip length by allocating a tradable portion of a county's or region's VMT to residents. People who drive less can earn income by selling the Share to others who drive more than is allocated. Transponders electronically track each person's mileage and credit or debit accounts.

A VMT Cap & Share program could help reduce congestion by increasing the value of the Share at peak hours, or by adopting other policies such as congestion pricing or tolls on certain roadways alongside the VMT limit. The program could encourage density and result in higher property values in mixed-use areas. Data for California counties suggest that a the Share would represent between 4,000 and 5,000 highway miles per year in urban counties, and between 5,000 and 15,000 highway miles per year in rural counties. Trading would be limited to drivers residing within a county.

Future studies could determine more specific cost impacts of a VMT Cap & Share program for local jurisdictions by analyzing the factors determining the number of trips and trip length such as age, income, population and household size, workers per household, auto ownership, and access to transit using census and other data. Another area for future research is the distribution of VMT by income to determine the program's potential regressivity.

Of course, the most important question not considered in this paper is the political feasibility of the program. Will Cap & Share for VMT join other good policies like carbon taxes that economists and planners like to talk about, but will never be implemented? Is this study headed for the bookshelf, never to return again? Until recently, the answer would have been: probably. But the era of peak oil and climate change may provide the urgency needed to bring innovative policies off the bookshelf and into reality. When that happens, let's hope our leaders have access to a well-stocked bookshelf.

End Notes:

Several people deserve mention for their work in developing ideas related to those mentioned in this paper. They include:

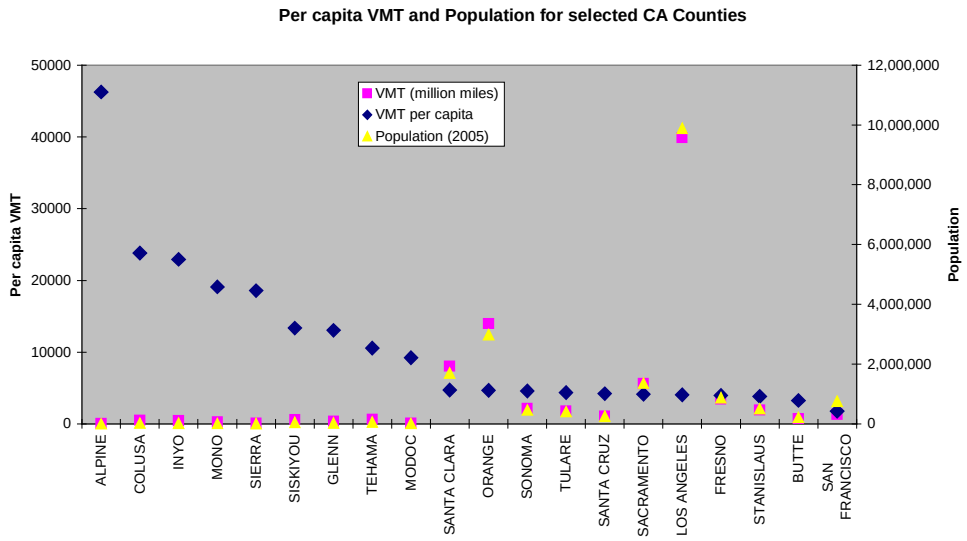
- Peter Barnes, author of Capitalism 3.0 and Climate Solutions (Cap and Dividend)
- Richard Douthwaite and FEASTA (Cap & Share)
- Aubrey Meyer, Contraction & Convergence (per capita equity)
- the late Joel Woodhull (Sky Trust for VMT)
- and the late Will Howard (Cap & Share)

IV. Illustrations

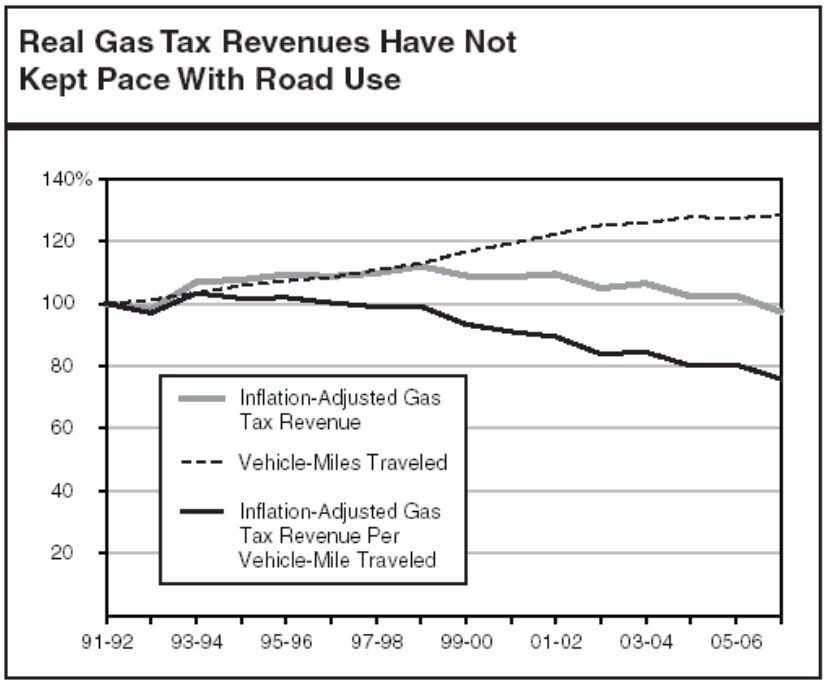
A.

County	VMT (million miles)	Population (2005)	VMT per capita
Top Ten Counties in VMT per capita			
ALPINE	52.1	1,126	46,270
COLUSA	492.3	20,675	23,811
INYO	407.1	17,743	22,944
MONO	244.5	12,806	19,093
SIERRA	62.2	3,347	18,584
SISKIYOU	594.0	44,459	13,361
GLENN	359.5	27,572	13,039
TEHAMA	630.7	59,702	10,564
MODOC	85.7	9,294	9,221
Bottom Ten Counties in VMT per capita			
SANTA CLARA	8015.6	1,698,642	4,719
ORANGE	13948.6	2,982,262	4,677
SONOMA	2122.2	463,631	4,577
TULARE	1772.9	406,491	4,361
SANTA CRUZ	1053.6	250,360	4,208
SACRAMENTO	5591.7	1,361,962	4,106
LOS ANGELES	39906.1	9,891,484	4,034
FRESNO	3453.5	873,364	3,954
STANISLAUS	1913.1	501,084	3,818
BUTTE	701.2	215,208	3,258
SAN FRANCISCO	1316.2	751,461	1,752

B.

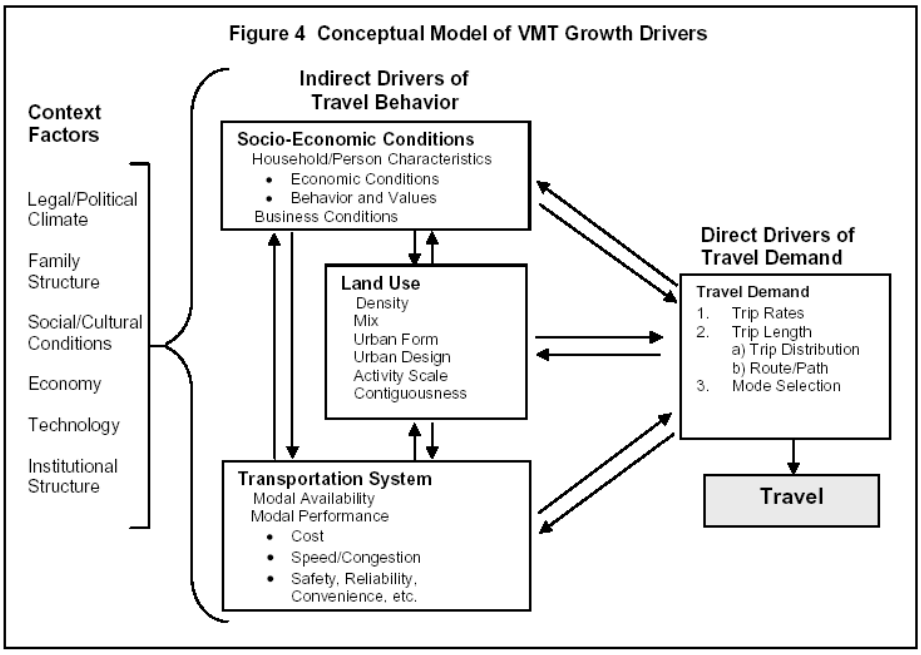


C.



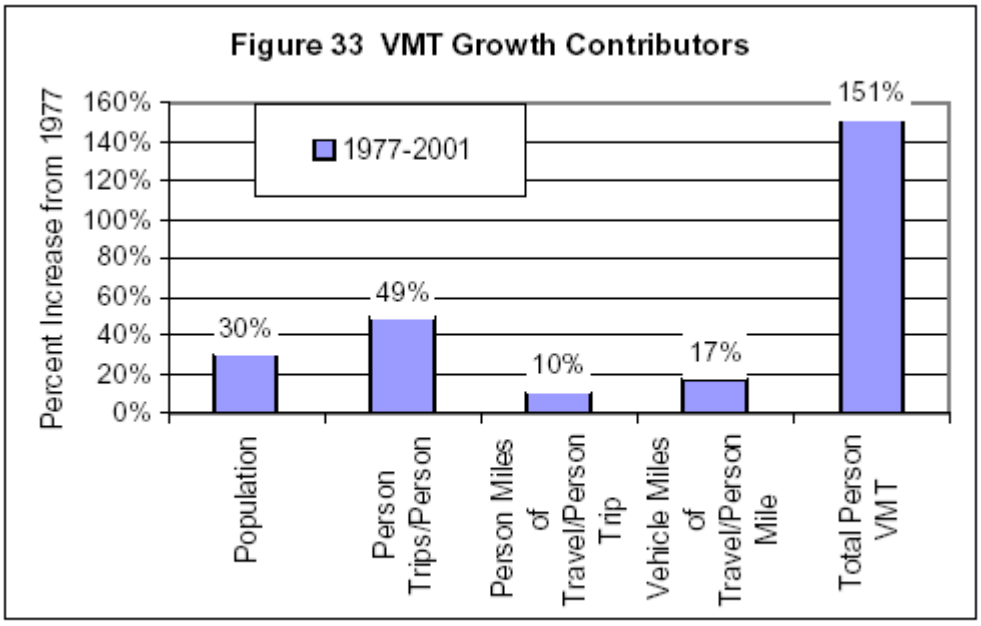
Source: CA Legislative Analyst's Office
http://www.lao.ca.gov/handouts/transportation/2008/Transportation_funding_issues_04_02_08.pdf

D.



Source: Johnston, Robert A., Jay Ro Lund, Paul P. Craig. "Capacity-Allocation Methods for Reducing Urban Traffic Congestion" *Journal of Transportation Engineering* Vol. 121, No. 1, pp. 27-39 (1995) and The University of California Transportation Center, No. 270.
http://www.uctc.net/papers/270.pdf

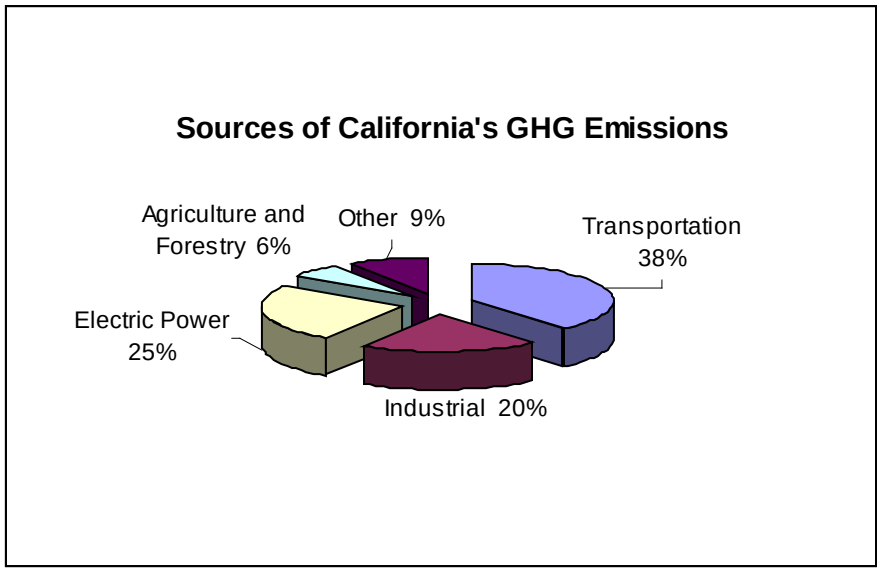
E.



Source: CUTR analysis with NHTS/NPTS.

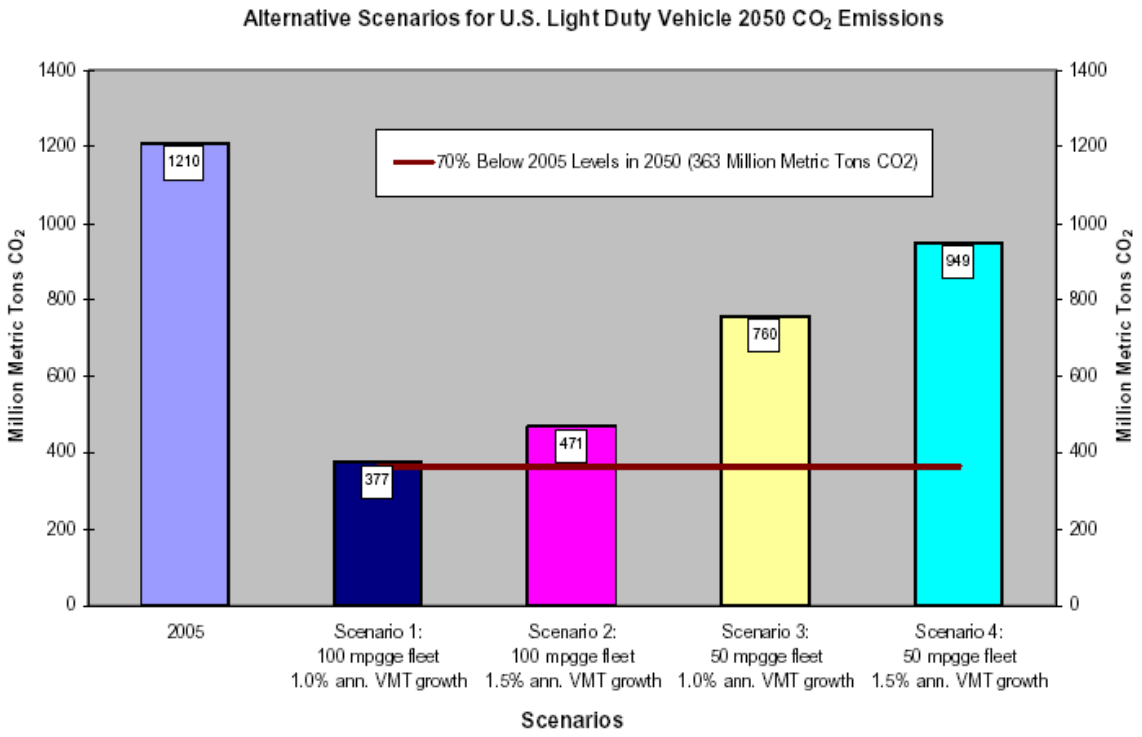
Source: Johnston, Robert A., Jay Ro Lund, Paul P. Craig. "Capacity-Allocation Methods for Reducing Urban Traffic Congestion" *Journal of Transportation Engineering* Vol. 121, No. 1, pp. 27-39 (1995) and The University of California Transportation Center, No. 270.
http://www.uctc.net/papers/270.pdf

F.



Source: Adapted from California Air Resources Board 2004 GHG Emissions by Sector
http://www.arb.ca.gov/cc/inventory/data/graph/graph.htm

G.



Source: Cynthia Burbank, Presentation at AASHTO Standing Committee on the Environment. Parsons Brinkerhoff. July 14, 2008.
http://www.dot.ca.gov/hq/maint/AASHTO/AASHTO_2008_Presentations/M4.2-CindyBurbankClimateChangePowerPoint.pdf

H.


FasTrak
Bay Bridge
Oakland


Congestion charging
Central ZONE
Congestion charging
Central ZONE