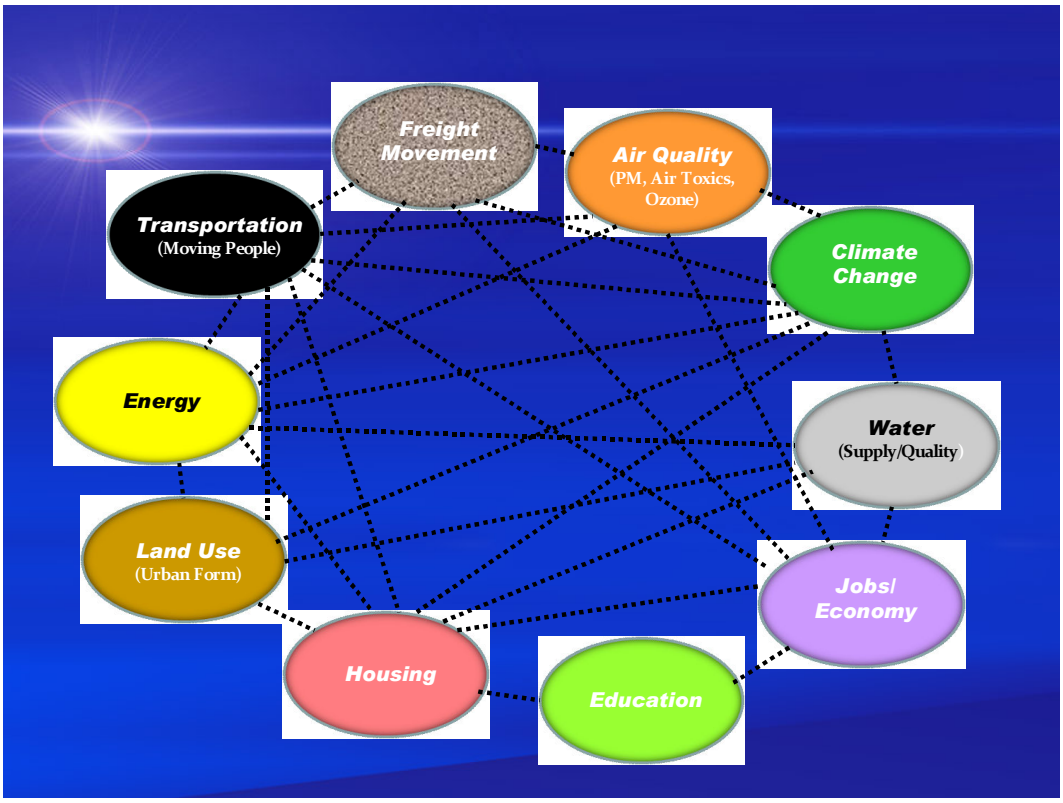
Transcending Silos:
A Perspective on Regional Issues



Presented to the Fortnightly Club of Redlands

By

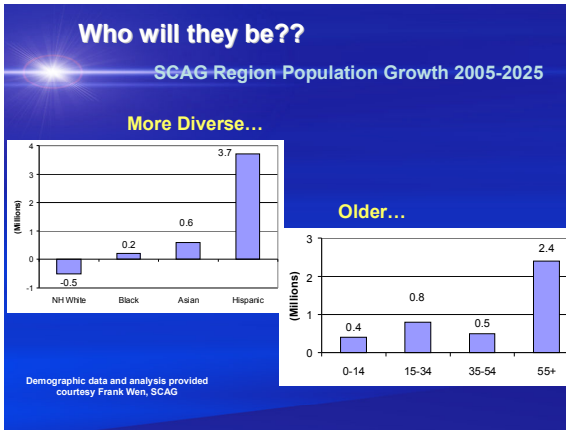
Ty Schuiling

December 16, 2010

Transcending Silos: A Perspective on Regional Issues

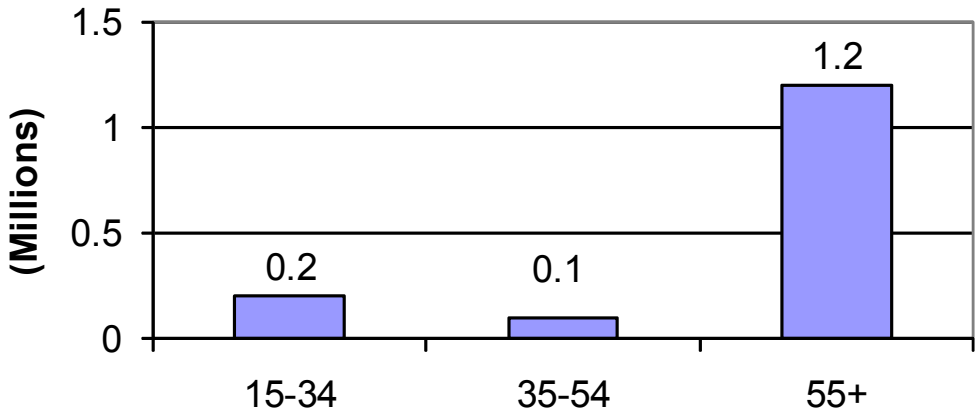
Silo – the term once reserved for tall cylindrical structures designed to hold the harvest, is heard more and more frequently now in reference instead to segregation or compartmentalization of knowledge. Expertise is claimed in many individual fields: economic development, finance, transportation, environmental quality, land development, energy, education and laborforce development, and water resources for example, but how much effort is expended, or attention paid, to inter-relationships among these fields that could, perhaps, be as significant as knowledge within the fields themselves? Formulation of public policy by agencies responsible for only one of these fields appears to frequently fall victim to this silo effect; what appears to make sense within the narrow confines of the agency's purview imposes unintended negative consequences in other areas. I'd like to explore a few of those inter-relationships among issues expected to confront Southern California in the next few decades and suggest, in 45 minutes or so, how strategies or policies intended to address issues in one area may synergize or parallel others conceived to address other issues.

First, demography. Southern California has witnessed explosive population growth since the early 1980s. We in the business of preparing federally or state-mandated plans for transportation, air quality, housing and the like, are fond of talking numbers: "in the next 25 years, the greater Los Angeles Region will add population comparable to adding a Chicago and a Houston," an increase from today's population of more than 18 million to a 2035 population that is expected to approach 24 million. We dig a bit deeper: we assess how many of them will comprise our future labor force, and compare that with the number of jobs we think the sectors represented in the Southern California economy can support to determine whether we can expect to be an importer of workers from other parts of the US and the world as we were in much of the 20th Century, or an exporter of people if insufficient economic growth forces our citizens to seek employment or an adequate living standard elsewhere. We consider how many of them are likely to be heads of households, so that we can estimate how many housing units will be needed to accommodate them.



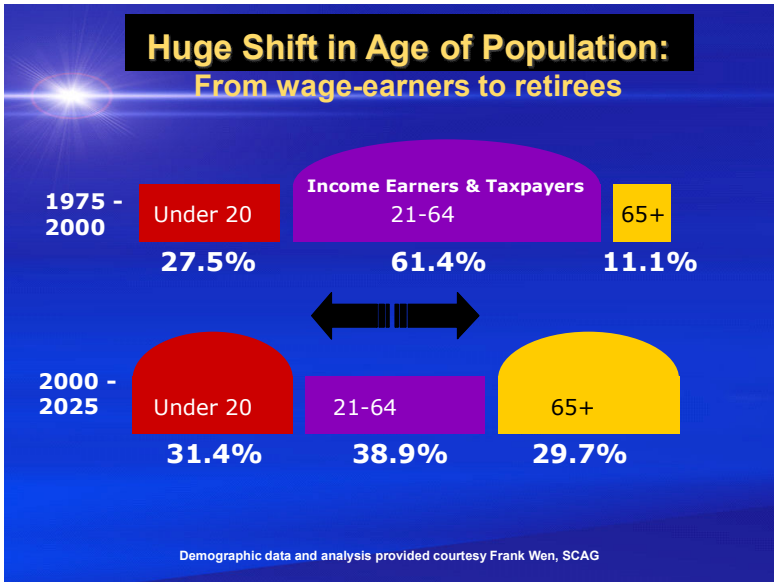
SCAG Region Population Growth 2005-2025: Ethnicity and Age

What we haven't done adequately in the past, however, is drill down a bit further to determine who these future residents will be, and what the answer to that question implies in relation to our institutions and public services, housing stock, transportation system, energy needs, and other factors. Yet the demography, unlike economics, is quite clear: we know, for example, that the region in the 20 years from 2005 to 2025 is experiencing a net addition of 4 million people of whom 3.7 million will be Hispanic.



SCAG Region Households Growth by Age 2005-2025

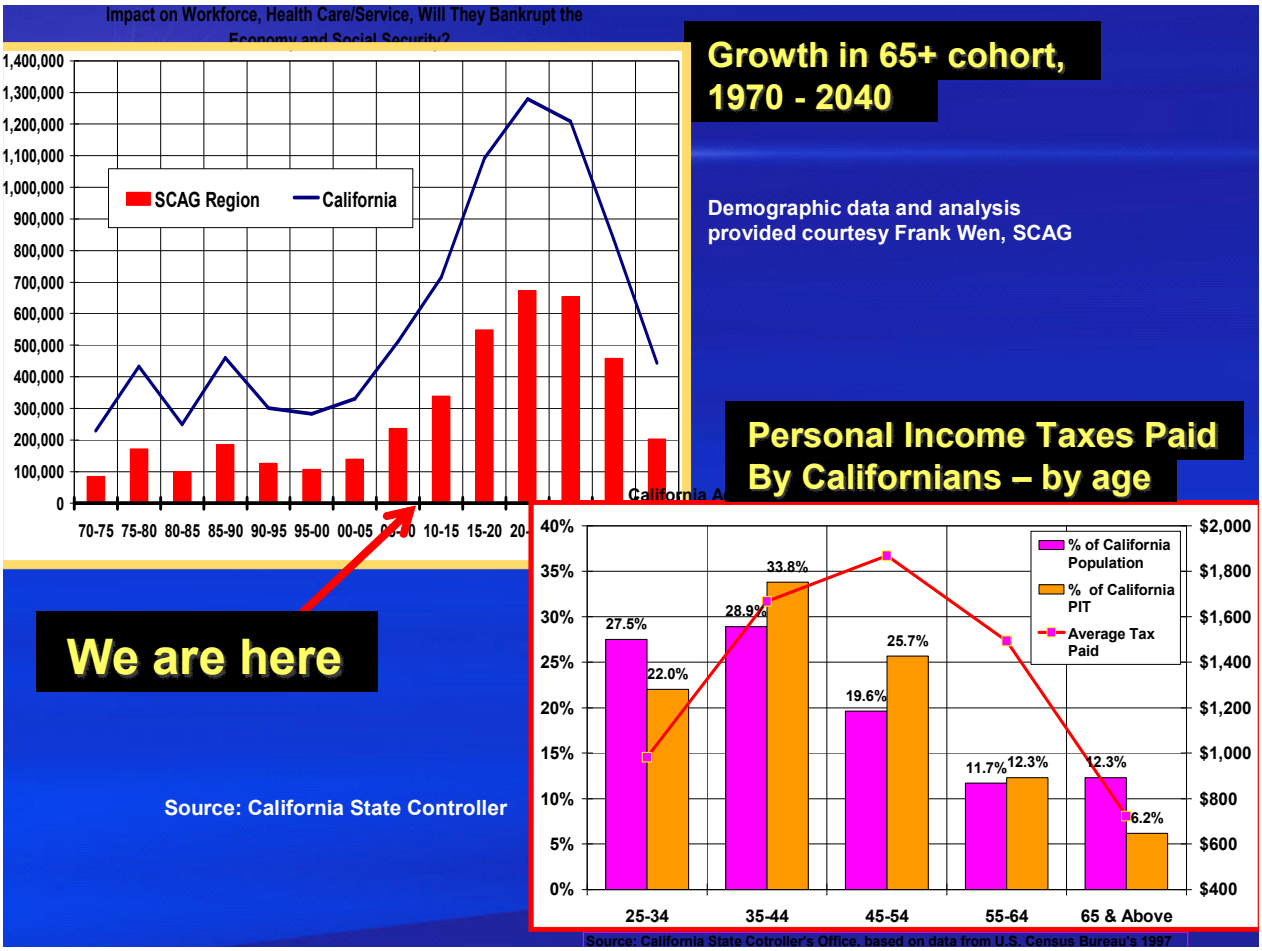
We also know that in the same time period, the net number of people added in the 55 and up age category will exceed the net number of people added in all other age categories combined. More remarkably, the number of additional households headed by people 55 and older will be four times the number of added households headed by those under 55. In short, groups still considered ethnic minorities today will be majorities, and the population as a whole will be significantly older. So what are some implications of these demographic changes?



SCAG Region: Shift from taxpayer dominance to dependent dominance

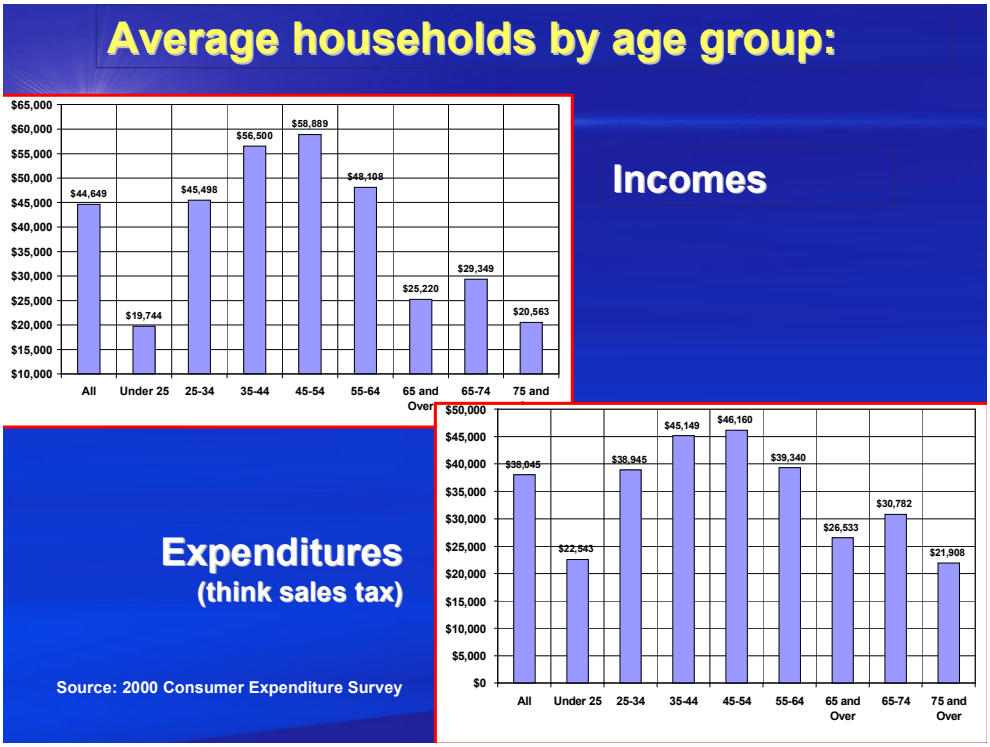
One well-known implication is its impact on education and entitlement programs: while prior to 2000 more than 60 percent of the population were wage earners and taxpayers supporting less

than 40 percent of the population who were under-age dependents and retirees, we are entering a period in which we'll see a reversal of that relationship, i.e., the wage earners and taxpayers will drop below 40 percent of the population while retirees and dependents will exceed 60 percent.



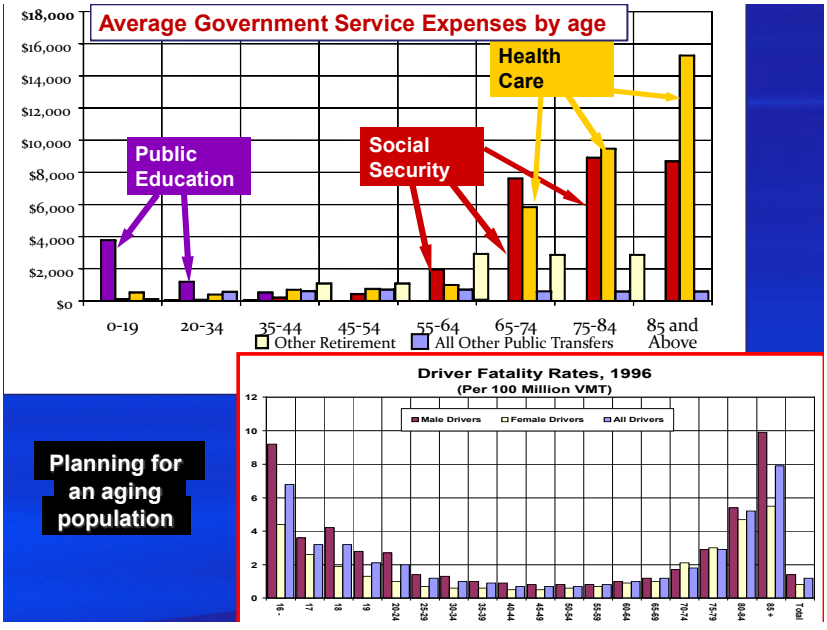
Effect of aging population on income tax revenue

The baby boom generation, an age group that represents a "pig in the [age distribution] python" because of its great numbers in relation to older and younger age groups, are even now beginning to move into their retirement years (the oldest, born in 1946, will be turning 65 in 2011). Federal Bureau of Labor Statistics data show that mean household incomes peak when the households are headed by individuals between the ages of 45 and 55, and decline thereafter: slowly at first as retirement begins to affect households headed by individuals over 55, then with increasing rapidity as 65 is reached and passed. Within 20 years, only boomers who elect to remain in the laborforce to age 67 or beyond will be salaried employees; most will be on fixed incomes.



Household Incomes and Expenditures by Age Cohort

Again, these implications are well known and I won't dwell on them here. However, less attention has been paid to its implications for federal, state, and local government finance. As average household incomes fall with the age of the head of the household, so do income taxes paid by these households. Tax revenues for California, that relies very heavily on its progressive income tax to support its general fund, is already being – and will continue to be – impacted by this decline.



Government Services Consumed and Driver Fatality Rates by Age

Reduced household income and aging also affects household expenditures, and therefore the sales tax, that is a principal source of revenue for cities and nowadays has supplanted the gasoline tax as the main source of fiscal support for our transportation system. In short, this is a structural problem with our system of public finance that must be addressed, made more challenging by the fact that the younger and older dependent populations also consume public resources at differential rates.

Speaking of transportation, the aging of the population – the increasing number of elderly citizens among us - also creates concerns for safety if we remain a heavily auto dependent society. As shown here, it is apparent that above 70 years of age, auto accidents per mile driven increase to levels comparable with teenage drivers. It also raises questions regarding the adequacy and ability of our transit systems to maintain mobility for those who cannot or choose not to continue to drive.

And household composition is changing:

Household Type	1960	2005	2040
HH with Children	48%	32%	26%
HH without Children	52%	68%	74%
Single/Other HH	*13%*	*31%*	*34%*

Source: Arthur C. Nelson, Presidential Professor & Director of Metropolitan Research, University of Utah

As indicated by the research of Arthur Nelson of the University of Utah, changes to our household compositions also have some intriguing implications for housing. Southern California "suburban living" developed in an era in which about half of households included children living at home; that number has already been reduced to little more than a quarter of households and continues to fall. Living alone, the lifestyle of only 13% of the population 40 years ago, is expected to be the practice of 34% of the population within the next 20 years. This suggests that the era of constructing huge tracts of large lot detached single family houses is over, not because of development control initiatives, but because the residential market has no need for added supply of this residential product. Nelson, in fact, suggests that some areas already have a serious oversupply of large lot detached residences, and that some of these areas may comprise the slums of the future. The demographics suggest that what will be in demand instead is small lot detached and attached residential products in proximity to urban services and amenities – a group of products that are underrepresented in this area. These are not necessarily small houses, although average housing sizes are shrinking in the United States; they are perhaps better thought of as clustered. Senate Bill 375, the follow-on to Assembly Bill 32, the state's unique greenhouse gas reduction bill that was sustained by the recent failure of Proposition 23 in November, mandates preparation of regional plans for more compact, mixed use development and improved transit service for the purpose of reducing greenhouse gas emissions from light

and medium duty vehicles. On the issues of residential land use and "smart growth" at least, it appears likely that market forces alone will – or would have - addressed the issue regardless of the legislation that has created such controversy since its passage in 2008.

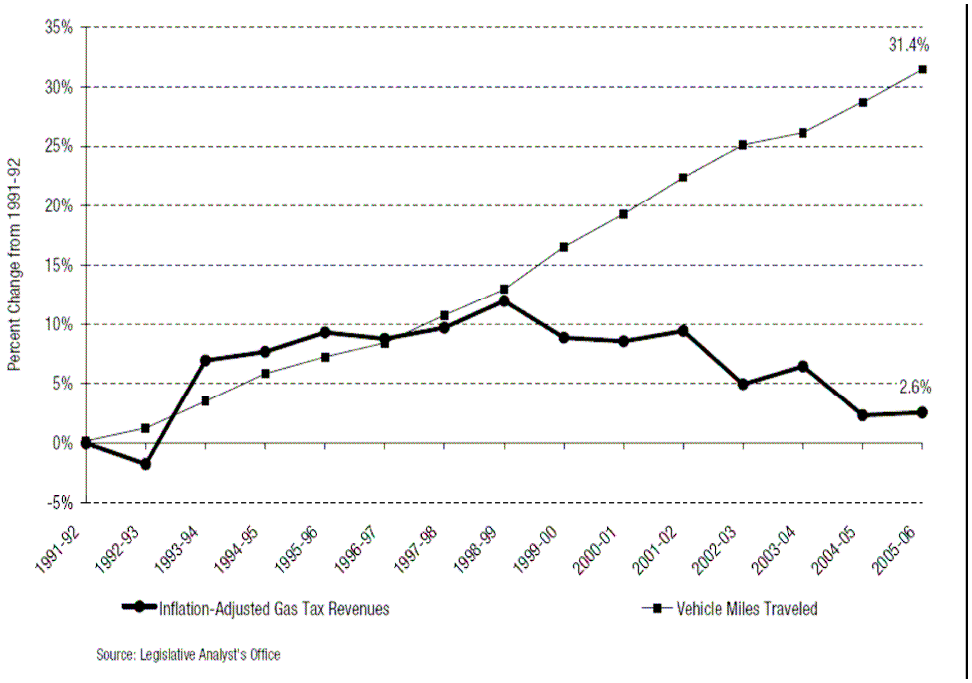
So to summarize some takeaways from demographics alone, we can expect continuing challenges to income and sales tax revenues that are among the cornerstones of state and local government finance, increasing demand for government services from expanding young and older populations, increased demand for small lot detached and attached residences but a potential surplus of large-lot (7,000 sq ft+) homes, and an increasing need for safer alternatives to the auto for our aging population.

California's Roads More Crowded Than Other States

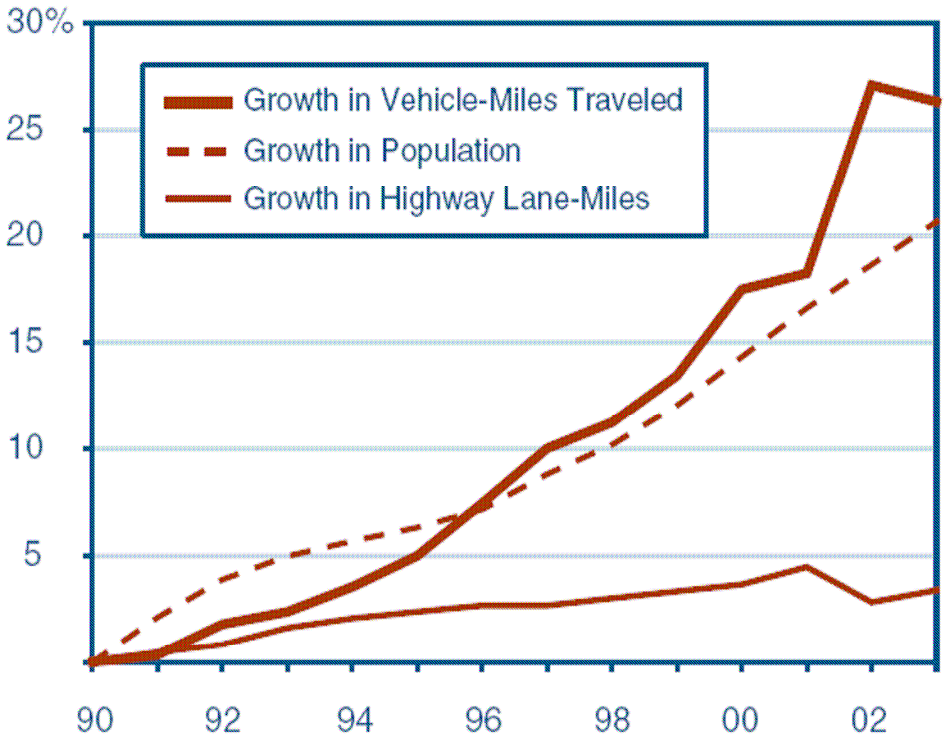
Rank (2003)	Urban Area	Miles Driven Per Highway Lane-Mile
1	Los Angeles-Long Beach-Santa Ana, CA	23,248
2	Riverside-San Bernardino, CA	21,429
3	San Francisco-Oakland, CA	20,242
4	Chicago, IL-IN	19,516
5	San Diego, CA	19,460
6	Sacramento, CA	19,303
7	Atlanta, GA	19,077
8	Miami, FL	19,057
9	Houston, TX	18,970
10	Oxnard-Ventura, CA	18,873

Source: California Travels – Legislative Analyst, 2007

Transportation represents another area of challenge for Southern California and the state as a whole as shown here by a graphic published in 2007 by the state Legislative Analyst's Office.

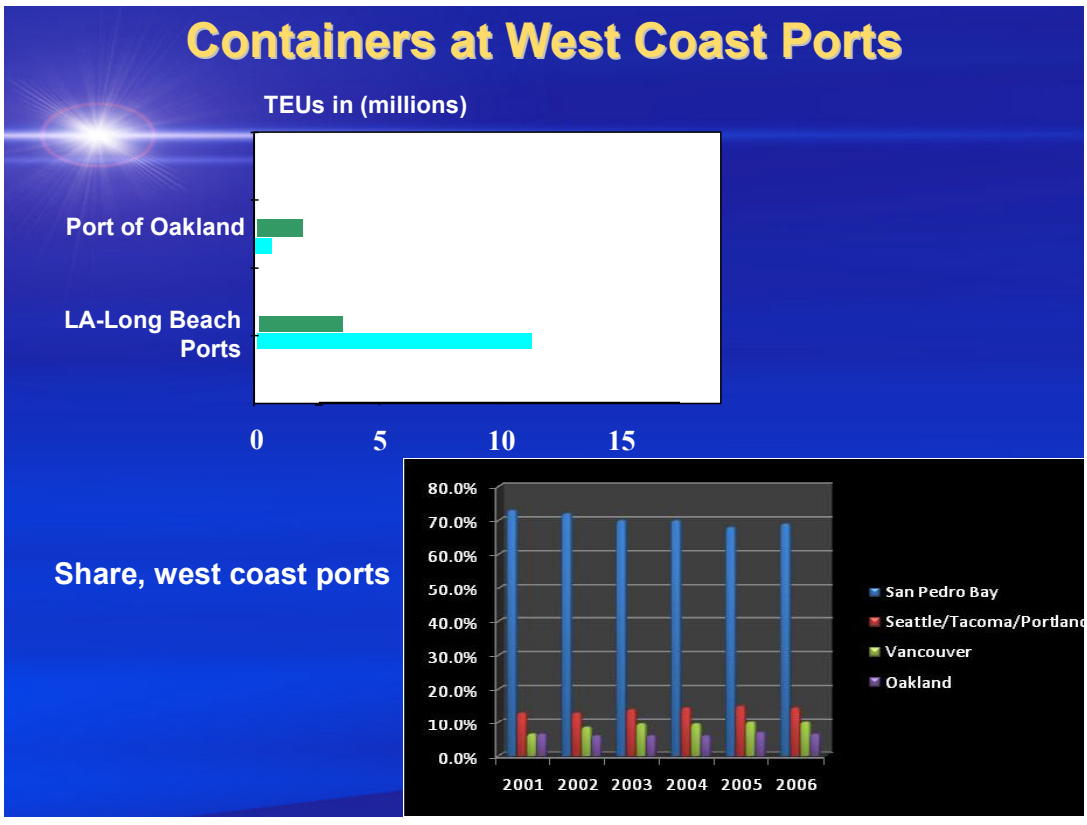


The state gasoline tax has not kept pace with growth in vehicle miles of travel, nor has system capacity kept pace with growth in population and miles driven.

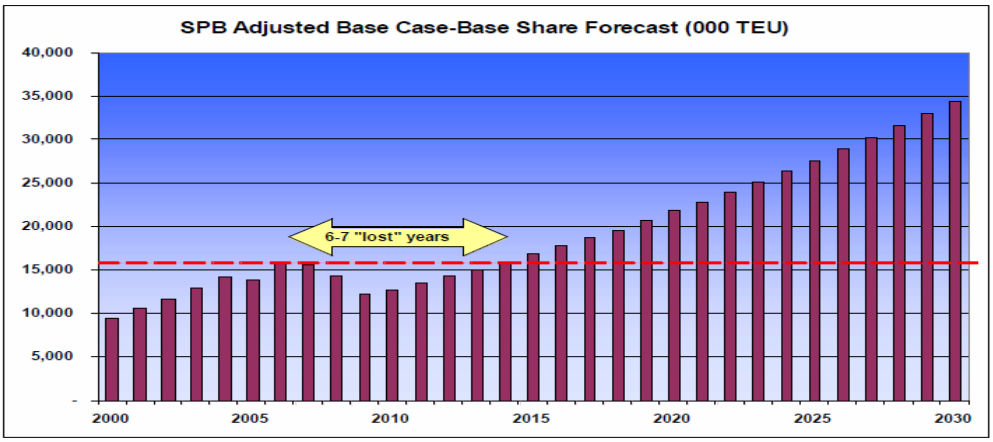


Source: State Legislative Analyst

Our transportation system is not oversubscribed merely because of too many cars, it also relates to the fact that our region is astride the largest intermodal freight corridor in the United States, responsible for transporting international goods worth about a third of a trillion dollars thoughout the entire United States each year.



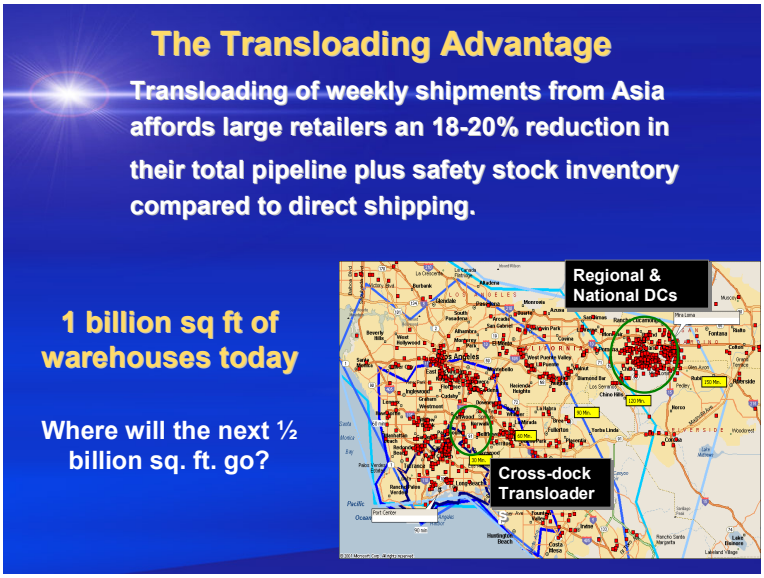
Unlike most other ports in the United States that principally support their regional economies, the ports of Los Angeles and Long Beach, which in combination are the world's fifth largest port at this time, provide intermodally transported goods destined for the entire United States. And what is the ports' prognosis looking forward?



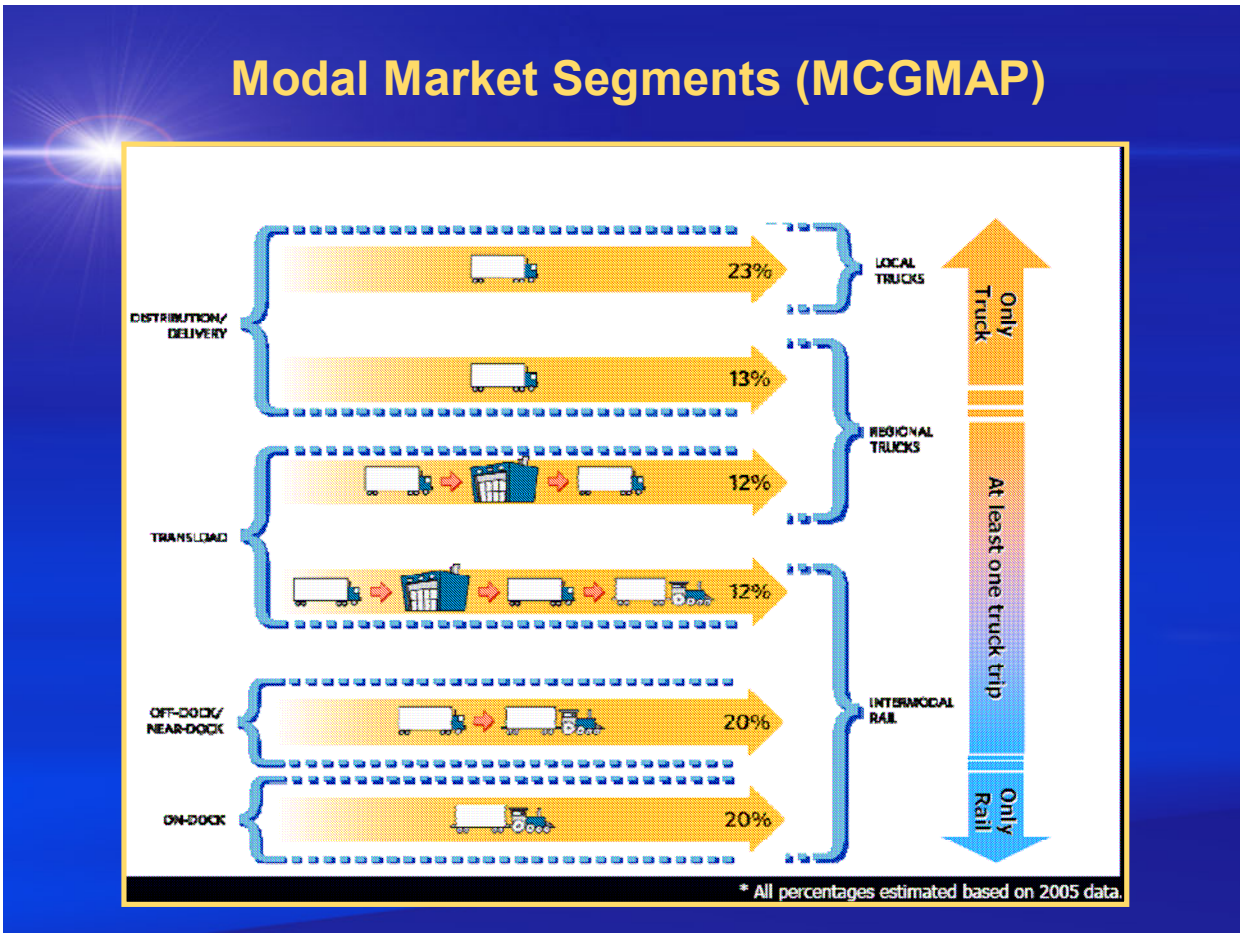
Source: San Pedro Bay Ports Forecast, 2009-2010

Only a few years ago, the ports were processing throughput totaling more than 16 million twenty-foot equivalent units or TEUs, and were believed to be en route to reaching maximum port capacity, 42 million TEU, by 2025. The recession then reduced throughput to about 12 million TEA by 2009, and it was thought that a slow recovery, coupled with the widening of the Panama Canal to accept post-Panamax ships, and increased competition from other West Coast ports would delay reaching maximum throughput to 2035. 2010, however, has proven to be a record growth year for the ports, leading to the current thinking that throughput will approximately triple and reach maximum port capacity by 2031.

Until 2005, public transportation agencies had little idea how the complex Southern California landside logistics system worked, and it was only through detailed market segmentation analysis and modeling by Rob Leachman from UC Berkeley and others that a reasonable understanding

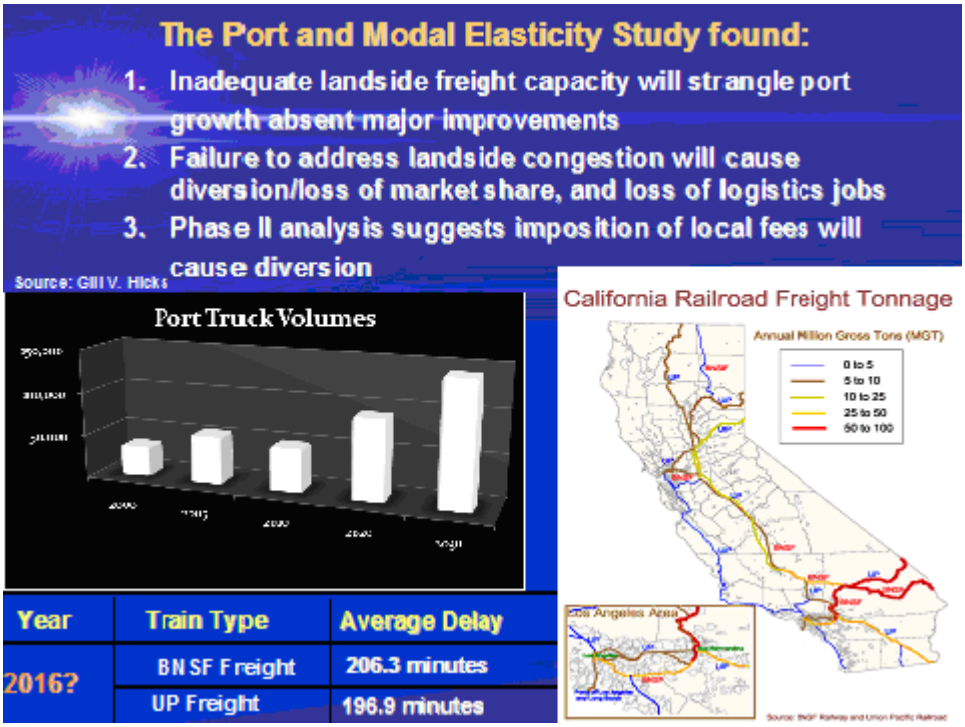


of the roles played by trucks versus trains, ondock rail and near dock intermodal facilities, crossdock transloading, distribution centers, and domestic intermodal facilities play in the scheme that provides Southern California with at least of portion of its competitive advantage.

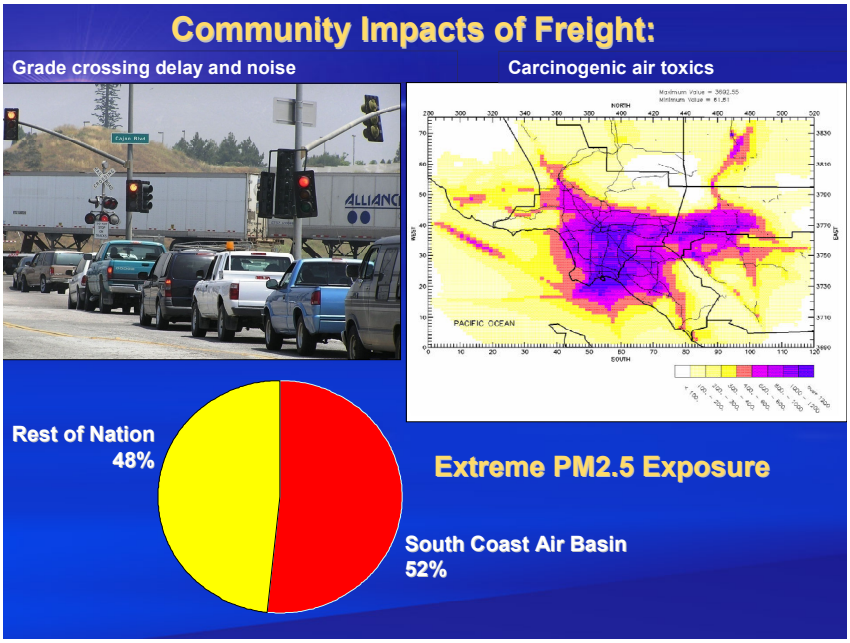


Market segmentation, SoCal logistics system (McGMAP)

It was this market segmentation analysis that demonstrated that only about one quarter of the freight moved through our ports originates or is consumed locally. Of the rest that is passing though us on our highways and rail lines, and creating a substantial share of our smog, a majority, mostly of relatively low value, merely uses us as a conduit to other parts of the United States, but a minority share, typically of higher value, undergoes handling within our warehouses and distribution facilities, thereby providing logistics jobs. For ease of discussion, these two categories have been given the somewhat useful tags, “bad freight” and “good freight” respectively. The tremendous landside investment to optimally manage the flow of “good freight” is also a source of Southern California ports’ competitive advantage and provides a measure of immunity to competition.

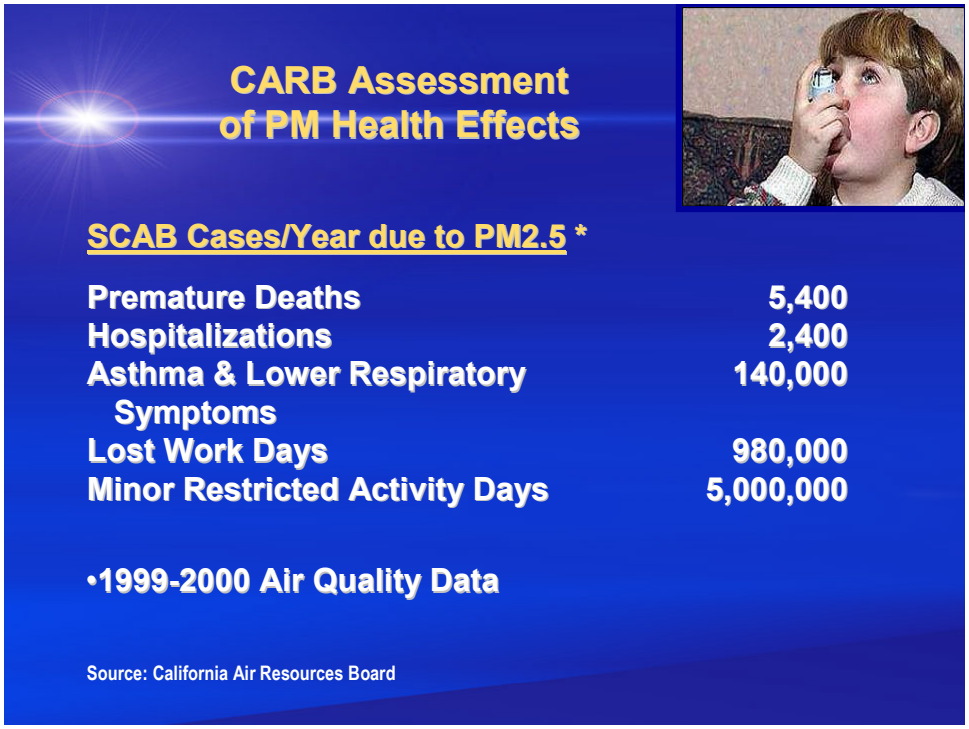


Leachman's work was arguably the first to make an utterly convincing case that the future growth of the ports is inextricably linked to the ability to provide for efficient and reliable landside movement of the port freight to out-of-state destinations, and recognize that several of the key bottlenecks are not adjacent to the ports but in the Inland Empire. His analysis of five years ago suggested that the ports' dominance was sufficient to support imposition of high container fees to fund landside infrastructure improvements and environmental mitigation. Recent work suggests this dominance has weakened, although the concept still has currency.



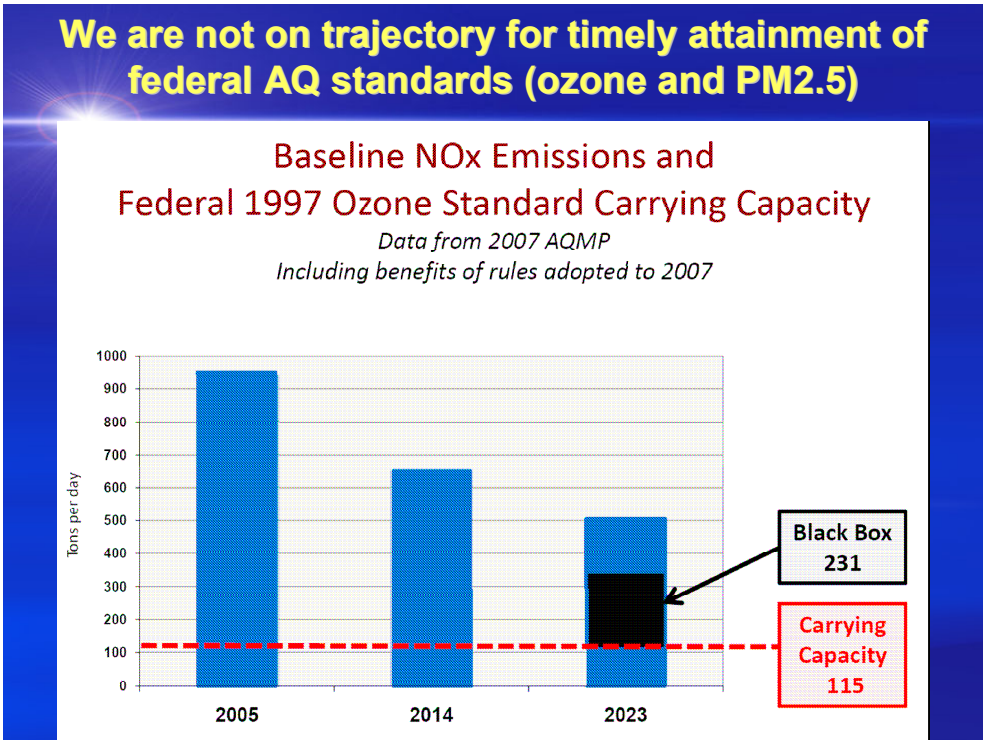
Citizens living along those inland freight corridors, however didn't need a UC Berkeley professor to tell them that increased train traffic was separating communities on opposite sides of railroad tracks, and that freight traffic in general was contributing to the nation's worst air pollution, including more exposure to extreme concentrations of fine particle pollution in the South Coast Air Basin than in the rest of the United States combined.

So let's turn our attention to air quality. It is certainly not the only serious environmental resource issue facing Southern California at present – water supply, water quality, and habitat protection come to mind –



but it is almost certainly the only one of these issues to which literally thousands of premature deaths are attributed each year in Southern California.

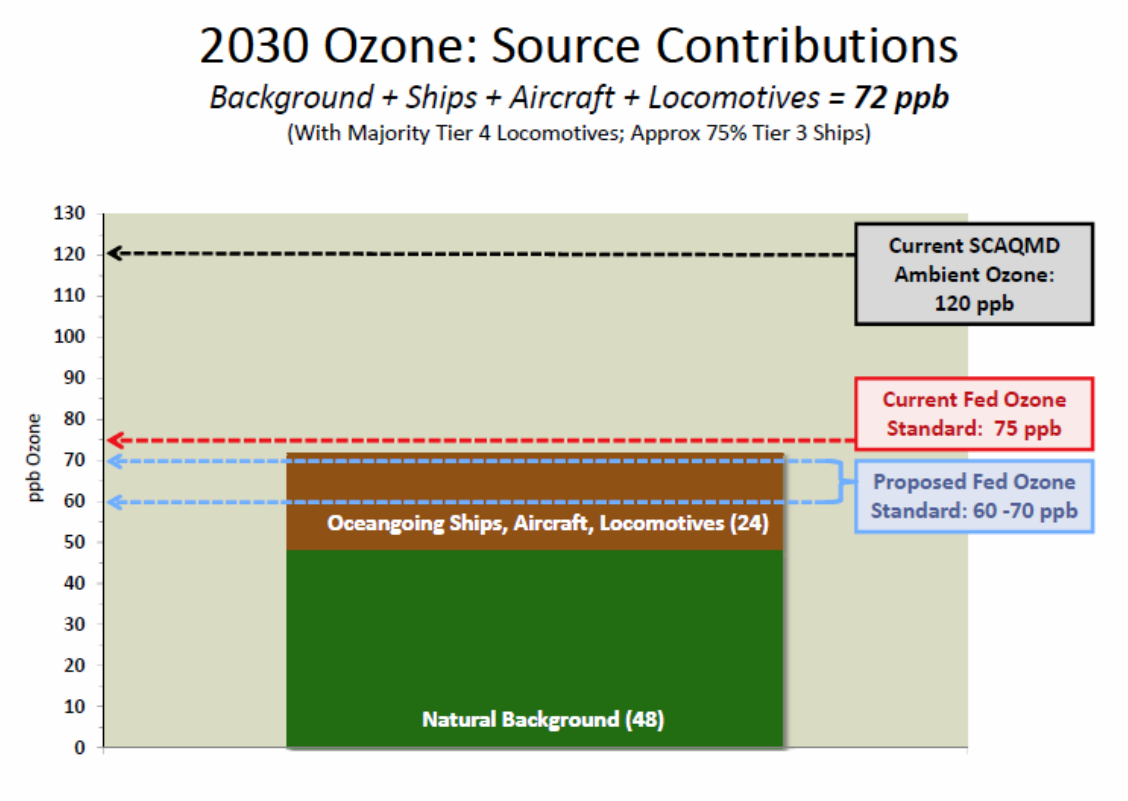
Some of us remember Redlands and San Bernardino being engulfed on 1960s summer afternoons in an orangish brown haze sweeping eastward from Los Angeles. Thanks to intense regulation or closure of smokestack industries, other stationary sources, and technologic improvements to automobiles, our air quality is now much better despite our much larger population. However, our rate of continued progress toward attainment of the federal air quality standards intended to protect human health is now modest at best, and the trend of our air quality improvement is not on a trajectory consistent with timely attainment of the standards – 2023 for the current 8-hour ozone standard and 2030 for the new, slightly more stringent standard, the promulgation of which is now delayed by the US Environmental Protection Agency.



A comparison by the South Coast Air Quality Management District of actual daily emissions against the best available estimate of the "carrying capacity" of the South Coast Air Basin, an area that encompasses most of LA County, all of Orange County, western Riverside County, and southwestern San Bernardino County, is telling. Despite all the measures and regulations by the US EPA, the California Air Resources Board, and the AQMD, both implemented and contemplated, the actual emissions of nitrogen oxide, a principal contributor to both ozone and fine particulate pollution, will remain hundreds of tons per day higher than the allowable amount consistent with attainment of clean air standards. Most of these excessive emissions are attributable to internal combustion engines in transportation sources: ships, trains, trucks, offroad equipment, cars, and aircraft.

In summary, this SCAQMD diagram indicates that by 2023 with implementation of all approved measures, the South Coast Air Basin will have NOx emissions that total over 500 tons per day, while the level of allowable emissions consistent with 8-hour ozone attainment ("Carrying Capacity") is estimated to be 115 tons. Why isn't much being made of the fact that we're not really on a course to timely attainment of these public health standards? Why hasn't the USEPA imposed sanctions on Southern California for failure to show how it will achieve timely attainment of these federal standards? It's because Section 182e(5) of the Federal Clean Air Act permits areas designated "extreme non-attainment" to take credit for "long term" air quality measures, presumably related to technologic advancement, that require no actual description. So, where are all these areas to which this special exemption applies? Since original passage of the Clean Air Act, there's been only one –we're it. Consequently, ours are the only air quality plans in the nation that are deemed acceptable despite not actually providing for the level of emission reduction needed to protect public health. And why is this region so fortunate? It's

because at the time of the Clean Air Act Amendments' passage in 1990 it was recognized that attainment in the South Coast Air Basin by 2010 (an attainment deadline for a less stringent standard than today's!) would require technologic advancement, and passage of the bill required that the greater LA area be provided a means to "demonstrate attainment" despite this problem.

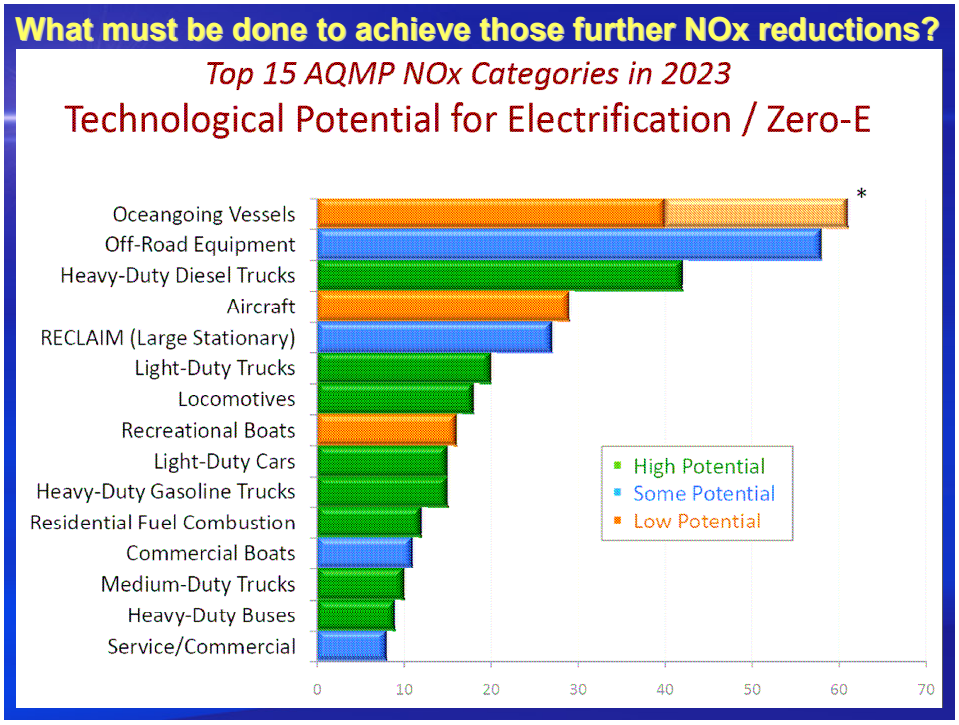


Source: South Coast Air Quality Management District, 2010

The implications of this are shown here. Think now in terms of atmospheric concentration of ozone in parts per billion, rather than tons per day of NOx, a contributor to ozone. As can be seen here, emissions from natural background, stationary and area sources that are already intensely regulated, plus aircraft and much cleaner ships and locomotives than are operating today will generate about 72 parts per billion ozone against a current federal standard of 75 and a proposed federal standard of 70 ppb or lower. This leaves no "headroom" for emissions from heavy trucks, off-road equipment, cars, and light trucks.

So what could these "long term" measures, these "new technologies," for the transportation sector be, and why, to this day, are we still allowed to avoid describing them in our air quality plans? Well, unless someone can come up with technologies that actually consume air pollutants, we must be talking about zero or near-zero emission vehicles. But …don't we have zero and near-zero emission vehicles today? What about today's Tesla, Nissan Leaf, and Chevy Volt? Aren't the European and Japanese rail systems electrified today? What about the General Motors EV-1 and Toyota RAV4 EVs of a decade ago? Isn't much of the San Francisco bus

system still running aged but highly functional zero emission electric buses? Didn't Southern California, until the late 1950's, have one of the most extensive electrified urban rail systems in the United States? So just how revolutionary must these technologic advances be…or is the real issue the political will to transform our transportation system away from internal combustion?

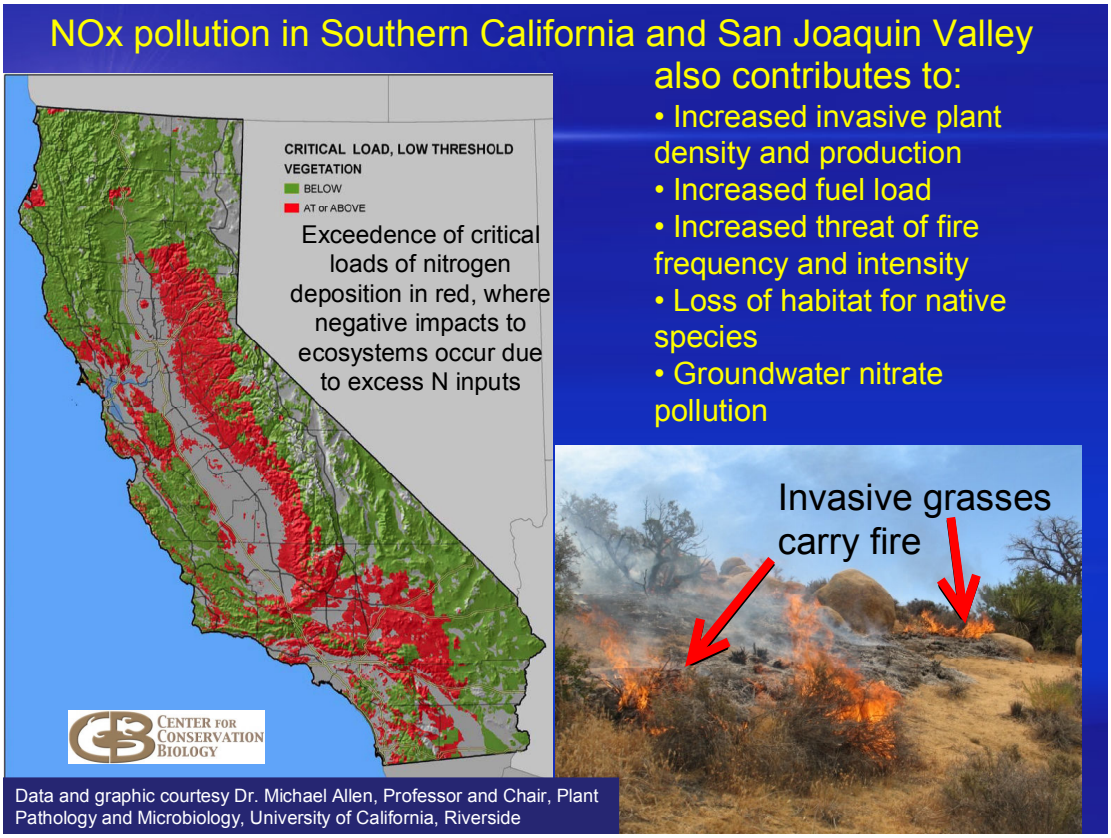


Source: South Coast Air Quality Management District, 2010

Reflecting back on the 115 tons per day carrying capacity for NOx again, and recognizing that 40 to 50 tons per day is produced by intensely regulated stationary sources and consumer products that simply can't be ratched down much further, it's apparent that all other sources will have to fit into a 65 to 75-ton envelope of allowable emissions. Let's look at the major sources of emissions as they're expected to be in 2023 based on existing and proposed regulations from the US EPA and the California Air Resources Board, along with their potential for further reductions through replacement of internal combustion engines with electrification.

Sources for which electrification (or any other zero emission technology) appears to be entirely unrealistic include airplanes and oceangoing vessels. Even with oceangoing vessels getting much cleaner than today, these source categories along (shown here in orange) consume the available capacity, leaving no room for emissions from cars, trucks, buses, locomotives, and the like. In short, simple math tells us we must electrify the surface transportation system or fail to meet federal health-based air quality standards. A final point: I've heard challenges to the 115 tons per day NOx carrying capacity on the grounds that there are, in fact, different combinations of VOC and NOx reduction that can achieve ozone attainment, some of which have higher NOx carrying capacities. However, the SCAQMD's focus on heavy NOx reduction is grounded in

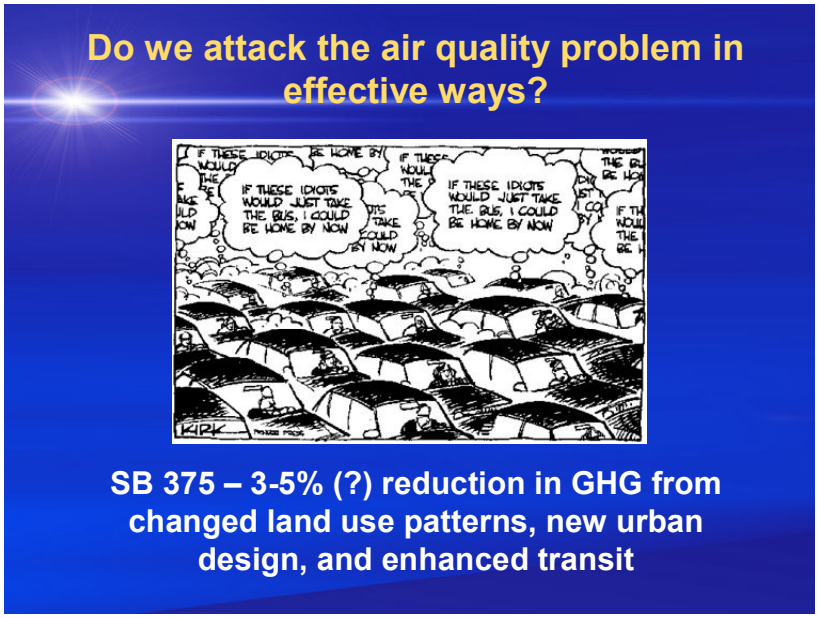
their recognition that heavy NOx reduction is also essential to attainment of the standards for PM2.5, which likely poses an even more severe attainment challenge and health threat than ozone.



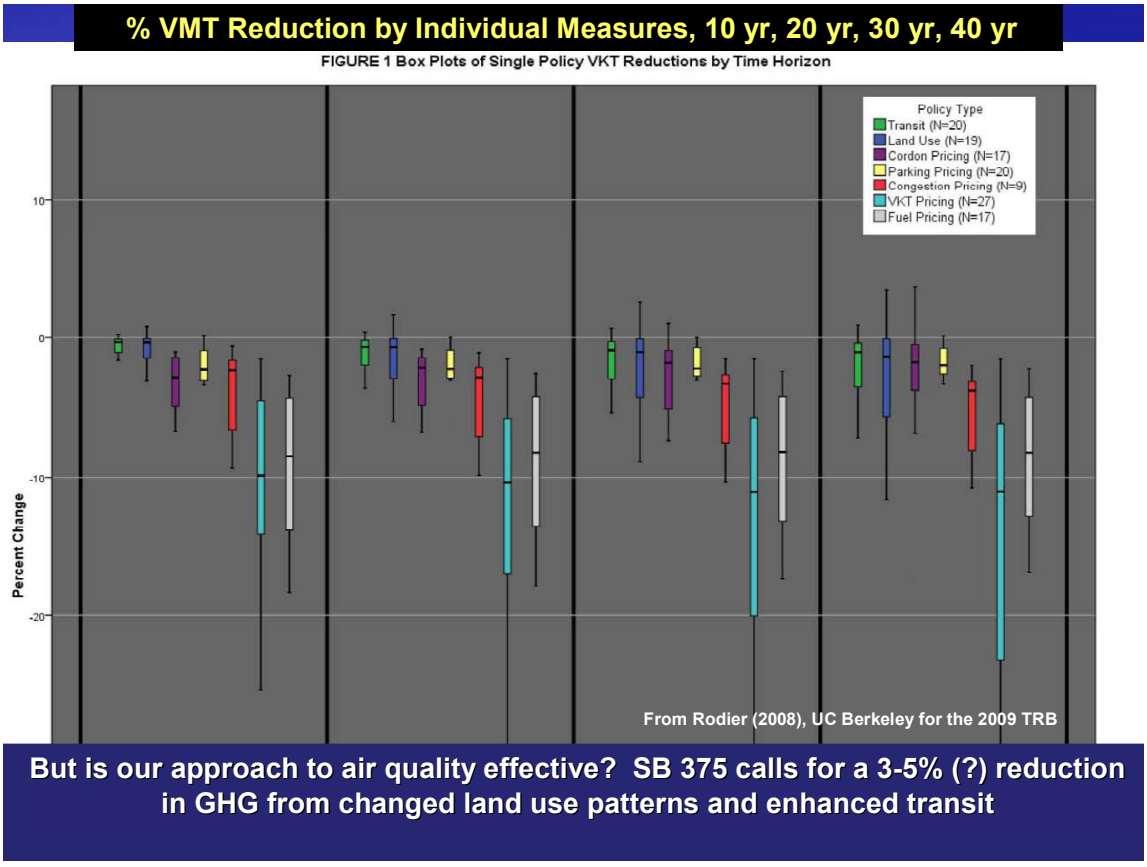
Source: Dr. Michael Allen, Chair, Plant Pathology and Microbiology, UCR

Before leaving the subject of the contribution of NOx to air pollution, it is also interesting to note that even our recent spate of severe forest fires can apparently be blamed, in part, on NOx pollution in Southern California and the San Joaquin Valley, according to recent research by Dr. Michael Allen of UCR. Absent the elevated concentrations of NOx acting as fertilizer, invasive non-indigenous grasses responsible in part for transmission of the fires would be less prevalent or not here at all.

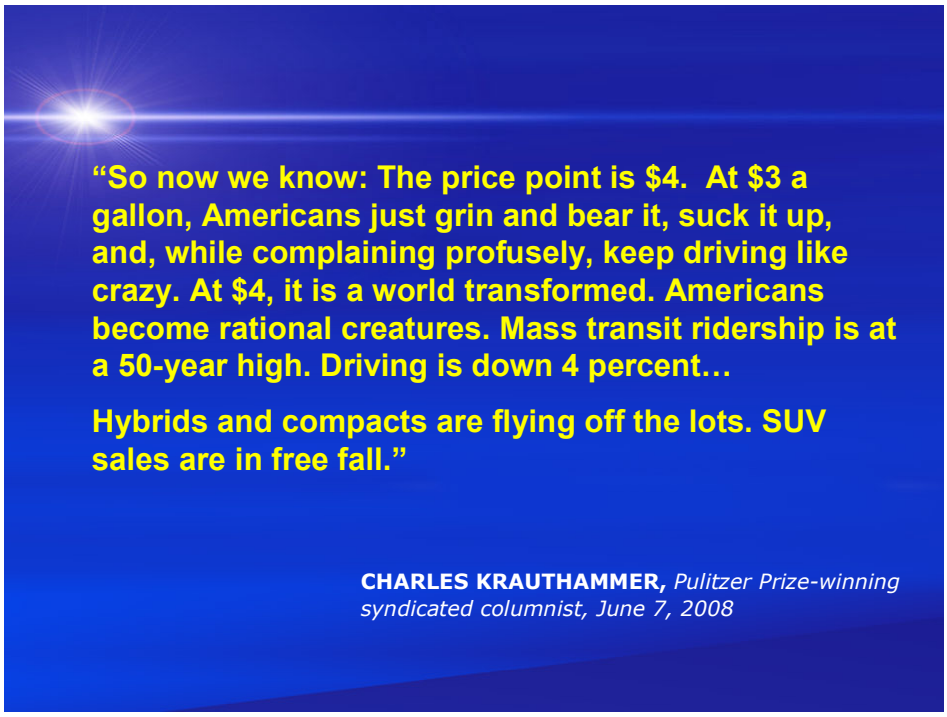
Frustratingly for regional planners, concern for our air quality problem has been subordinated in recent years to concern for climate change and greenhouse gas (GHG) reduction – frustrating not because GHG reduction is unimportant, but because ignorance of the most efficient and effective ways to achieve GHG reduction, and achieve synergies with air quality as well, have led the policy debate into some relatively unproductive directions.



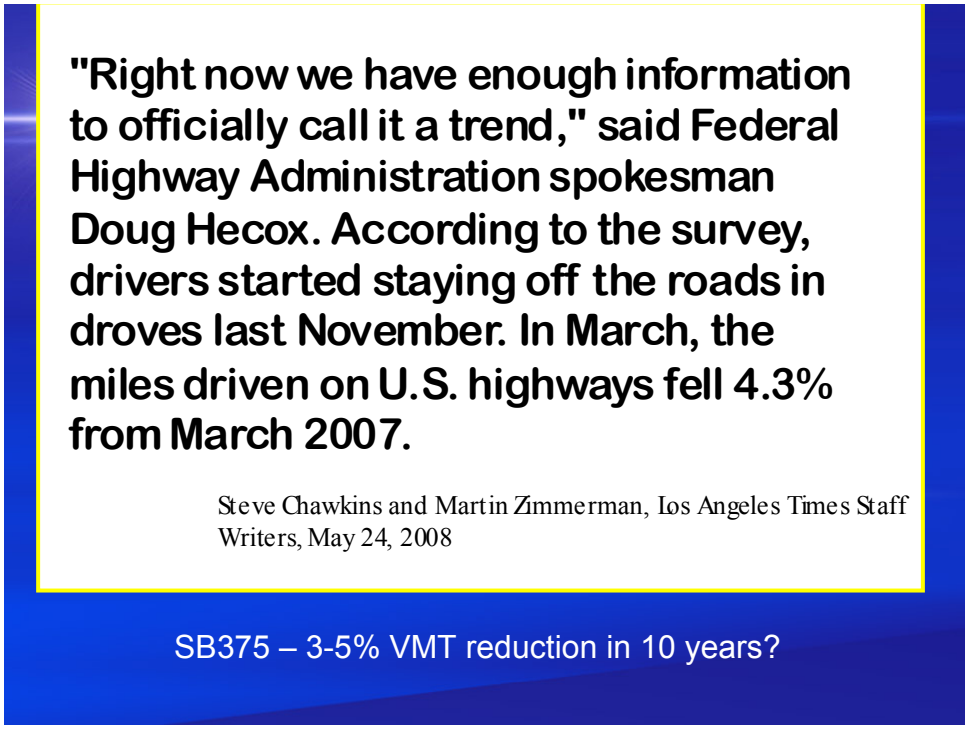
The California Air Resources Board (CARB), the agency responsible for reducing emissions from on-road vehicles in California, has claimed in recent years that tailpipe reductions alone could not achieve the state's GHG reduction objectives, and that substantial reductions in miles driven would be needed as well. CARB was then charged with implementation of SB 375, the state's initiative to reduce GHG emissions by changed land use and better transit.



Ironically, work by UC Berkeley's Institute of Transportation Studies, commissioned by CARB, has shown that in fact, changes to land use and transit are far less effective and much slower to show progress than pricing measures, including actions as technically simple as raising the gas tax.



The empirical data from the 2007 to 2008 run-up in gas prices clearly show this.



However, by refocusing the dialogue to reductions in miles driven and away from transformation of the on-road fleet as is needed for air quality, CARB has succeeded in moving the debate away from actions that are their principal responsibility to actions for which local governments and transportation agencies are responsible, and the environmental community in general has followed. You may have noted, for example, that the UC Berkeley graphic focused exclusively on reductions in vehicle miles traveled (VMT), meaning that the most effective air quality measures, fuel efficiency and technology, fail to even appear on the graph. In fact, if we indeed can achieve the near zero emission auto and truck fleet needed for air quality attainment, VMT reduction would no longer be a meaningful GHG reduction strategy.

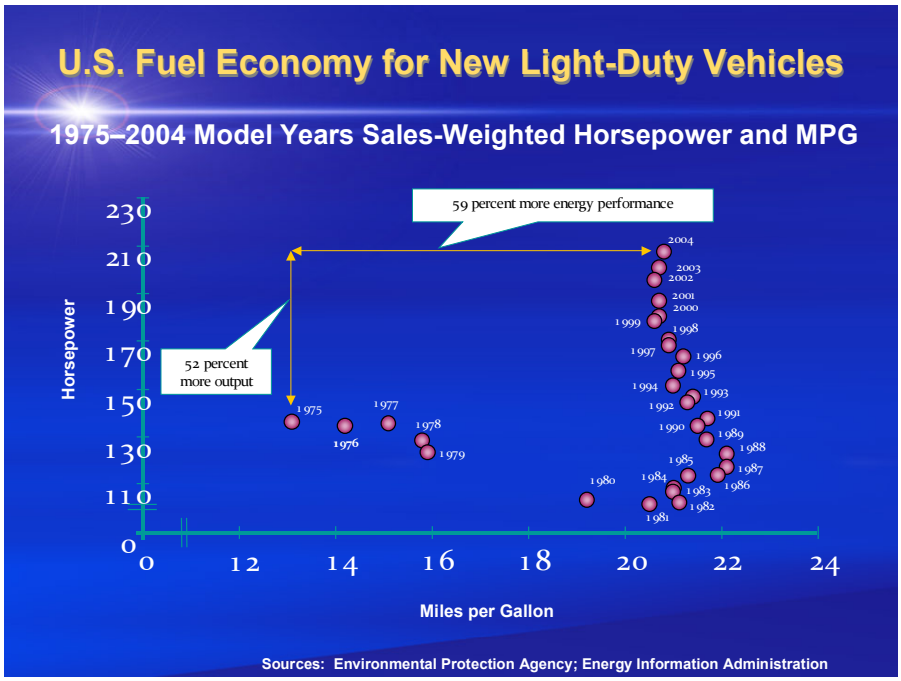
Technology?

	2004 Chevrolet Malibu	2004 Toyota Prius	Savings	Percent Reduction
EPA Emission Standard	Tier 2 Bin 8	SULEV II		
Non-Methane Organic Gases (grams) 2	1,527	122	1,405	92%
Carbon Monoxide (grams) 2	51,303	12,215	39,088	76%
Nitrogen Oxides (grams)2	2,443	244	2,199	90%
Particulate Matter (grams)2	244	122	122	50%
Carbon Dioxide (lbs)3	10,470	5,330	5,140	49%
EPA Fuel Economy (city/hwy)4	24/34	60/51		
EPA Fuel Economy (combined)5	28	55	27	
Fuel Consumed Annually (gallons)	436	222	214	49%

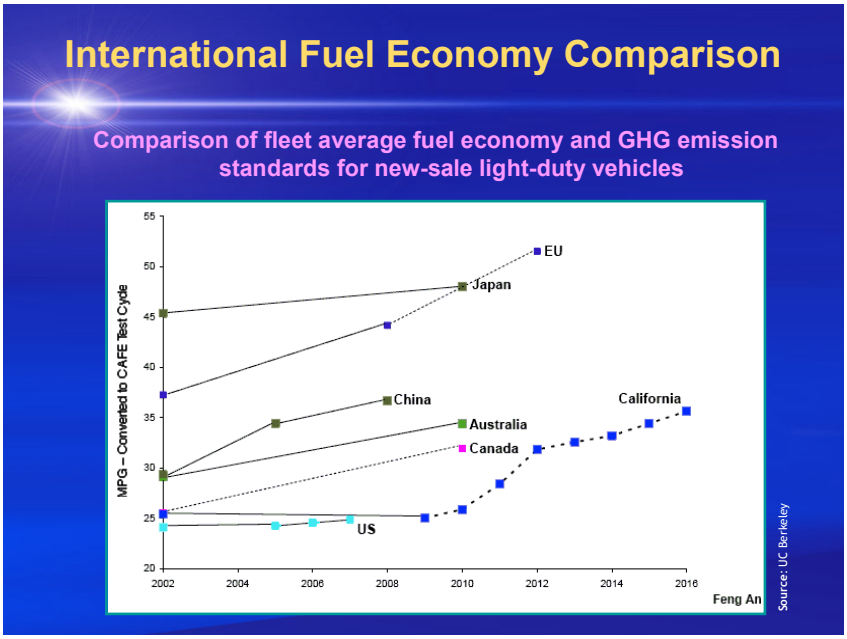
Notes
1. Based on 12,215 annual mileage.
2. Data obtained from Smog Forming Pollutants Chart, EPA Green Vehicle Guide: www.epa.gov/autoemissions/0-10chart.htm
3. Calculated using (12,215 miles / Combined MPG) x (24 pounds CO2/gallon). Includes upstream CO2 emissions and end-user CO2 emissions. David Friedman, Senior Engineer, Union of Concerned Scientists. Personal communication 7/25/2003.
4. Fuel economy rating for automatic/continuously variable transmission.
5. Assumes 55% city driving and 45% highway driving.
Emission Standard Key: Vehicles meeting the Federal Tier 2 Bin 8 standard produce: 4.2 g/mi of CO, 0.02 g/mi of particulate matter, 0.2 g/mi of NOx, and 0.125 g/mi of non-methane organic gases. Vehicles meeting California's SULEV II (Super Ultra Low Emissions Vehicle) standard

While SB 375 constitutes a mandate on local governments to in effect, achieve VMT reductions of about 8% in the next decade and 13 to 17% in the next 25 years, the simple act of swapping out a 2004 Chevy Malibu for a 2004 Prius yields a 50% reduction in CO2 and 90% reduction in NOx.

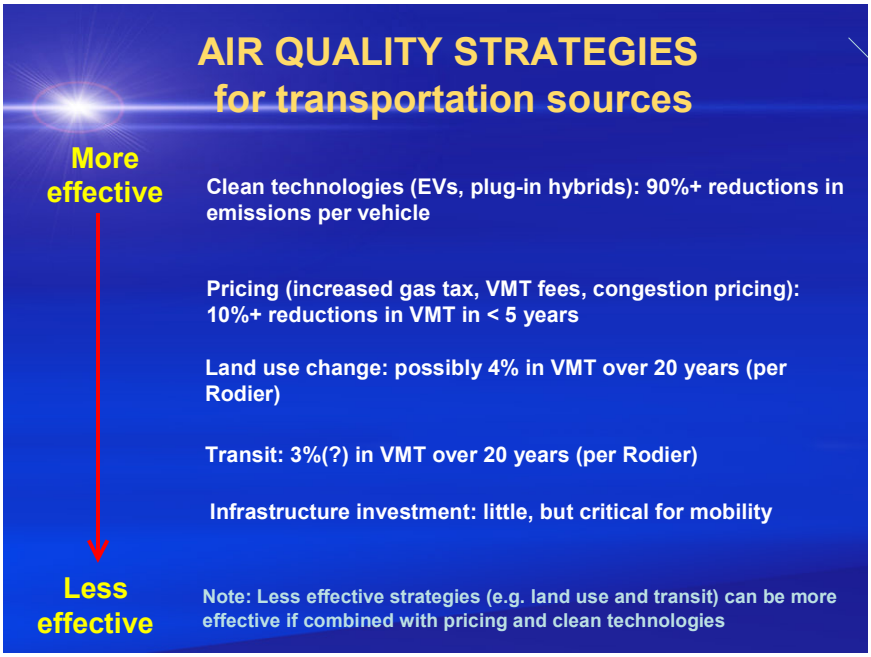
The power of gasoline price on fuel efficiency, and therefore on greenhouse gas emissions from automobiles, is shown by these data from the US Environmental Protection and Energy Information Agencies:



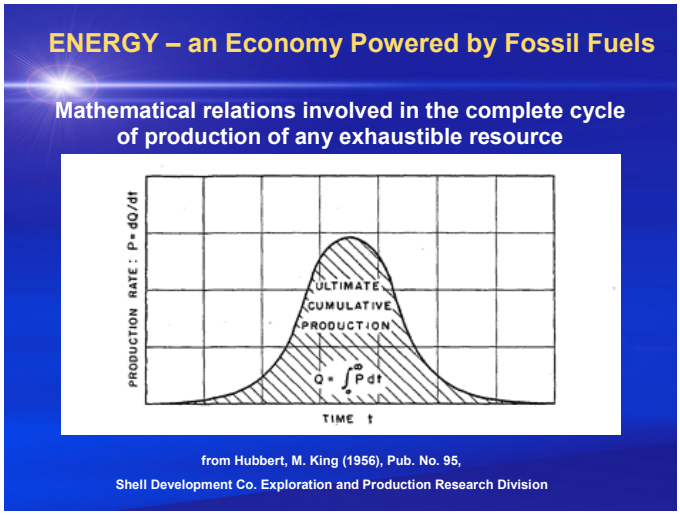
The US auto industry responded to the Arab oil embargoes and high petroleum prices of the mid-1970's to mid-1980s by improving the average fuel efficiencies of American automobiles from about 13 miles per gallon in 1975 to about 22 miles per gallon by 1985. Then, in the era or remarkably cheap gas, when OPEC nations drove prices down by overproducing in search of hard currency, any further improvements in fuel efficiency were forgotten while average horsepower was increased from about 120 in 1985 to 220 in 2004.



Consequently, US vehicles have lagged behind vehicles of other nations in fuel economy. Earlier this year, in recognition of the need to work toward energy security, the federal government enacted new Corporate Average Fuel Efficiency (CAFÉ) standards to achieve an average fuel efficiency of about 35 miles per gallon among new vehicles sold in and after 2016.

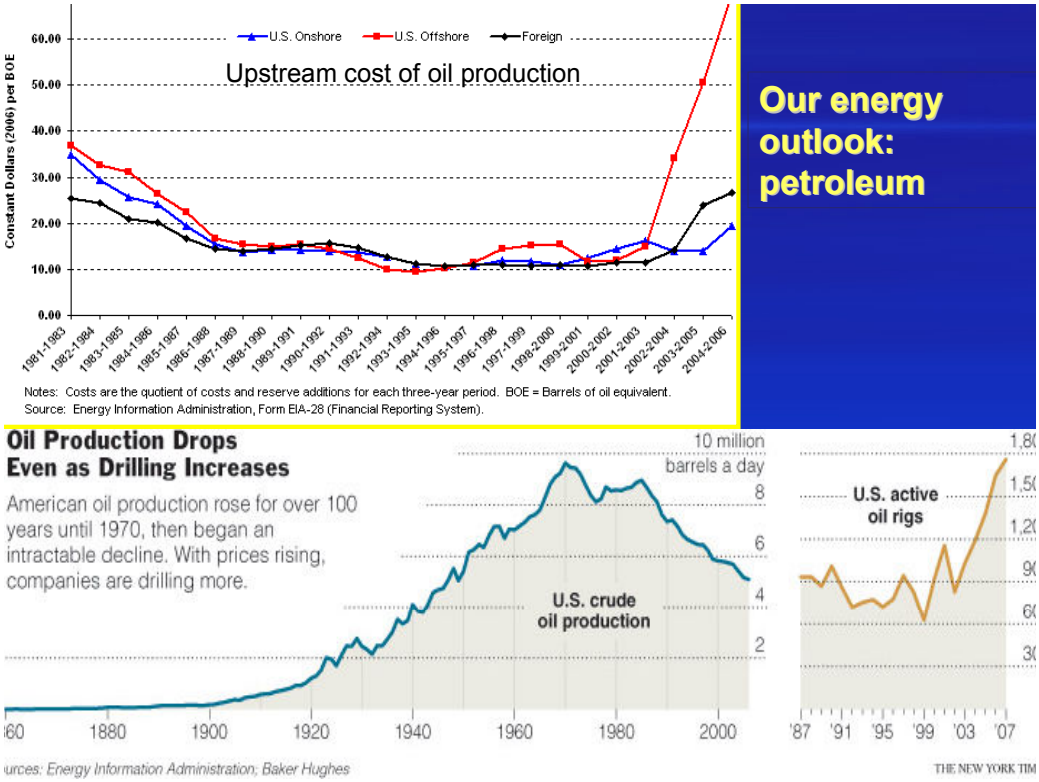


In summary for air quality and climate change, then, despite abundant evidence that technology, followed by pricing, are the strategies that yield the largest and most immediate air quality benefits, California's climate change strategy for transportation seems to have a laser-like focus on slow and relatively ineffectual methods that additionally have little synergy with our air quality needs.

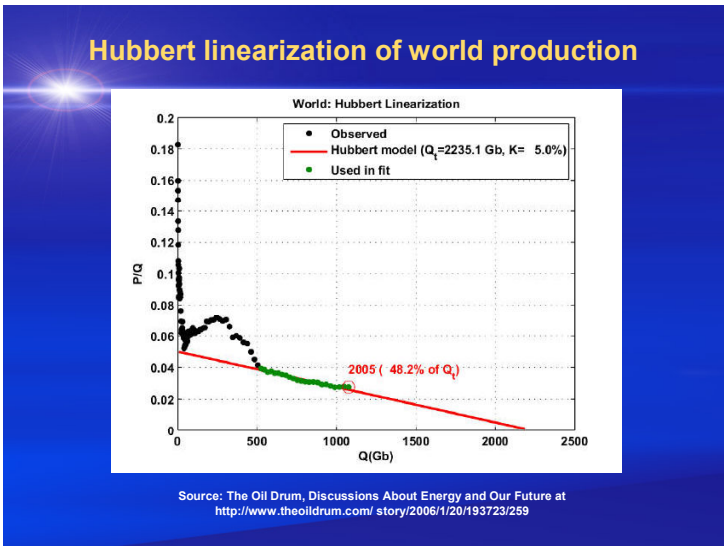


Let's now focus attention on energy, an issue I addressed in my last Fortnightly paper in March 2008. At that time, I noted that the world was at or near peak production of conventional oil as

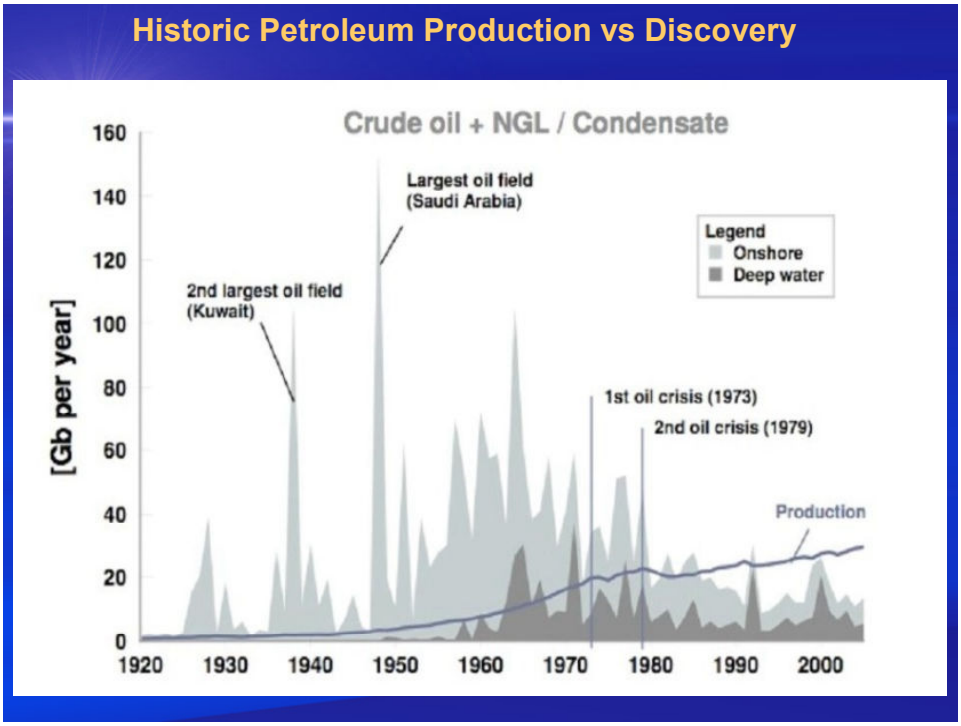
oil prices were rising rapidly through $100 a barrel. The petroleum price peaked at over $140 per barrel in July 2008, followed by a rapid decline as the world economy crashed, bringing demand for oil back in line with supply.



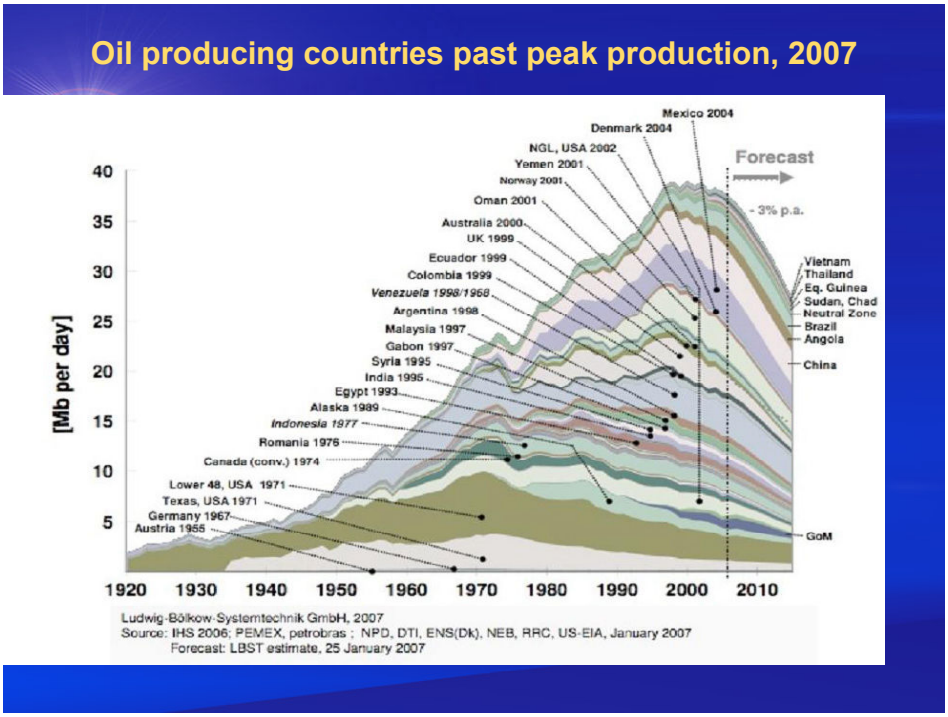
Through it all, world production of conventional oil declined very slightly with the difference made up with liquid hydrocarbons derived from natural gas production, while petroleum prices and levels of exploration drilling fluctuated wildly, and costs of production increased throughout the last decade.



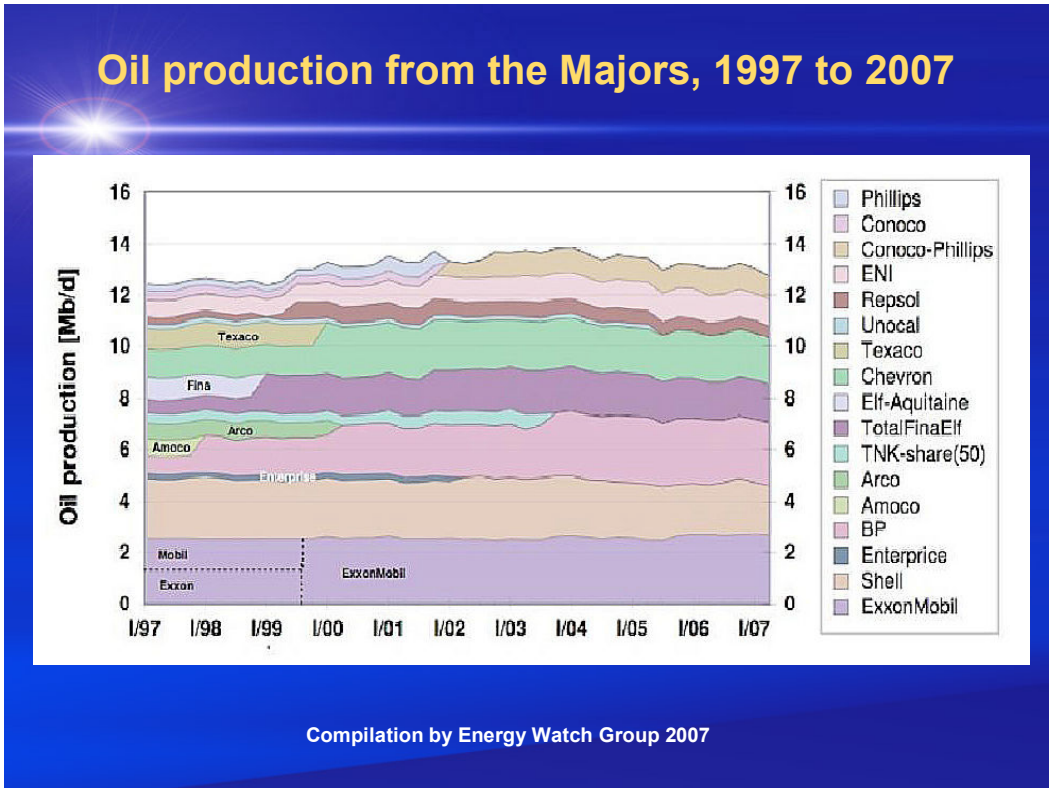
Nothing has occurred to change the basic thesis at that time, that ultimate production of conventional petroleum will total around 2 ¼ trillion barrels as indicated by Hubbert linearization, and that petroleum production to date has been approximately half of that total.



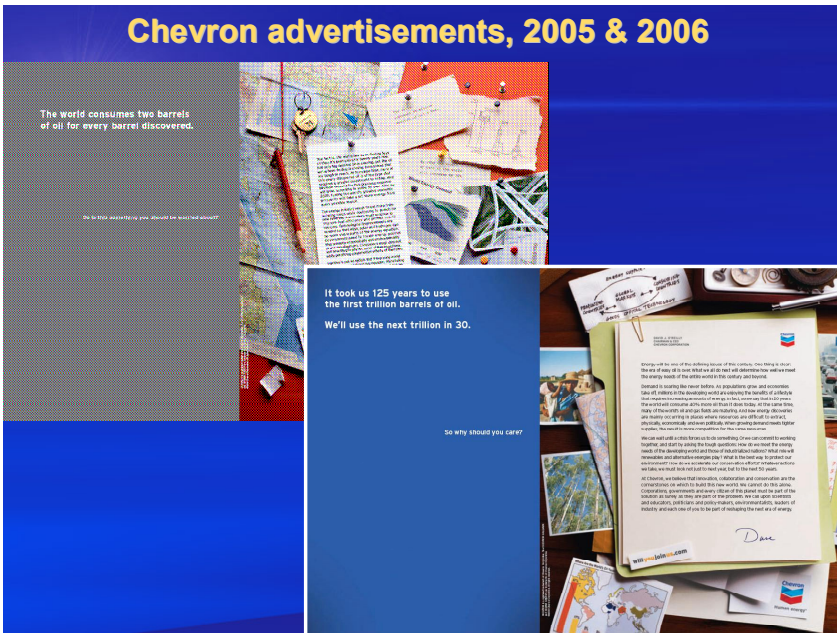
Petroleum discovery has failed to keep pace with petroleum production for the last 25 years,



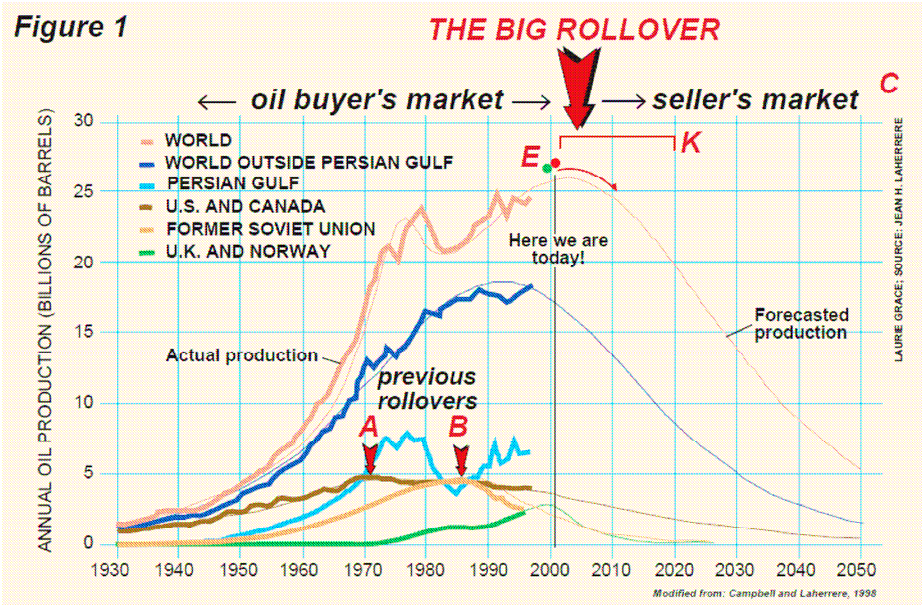
and production has peaked and begun an irreversible decline in most petroleum-producing countries.



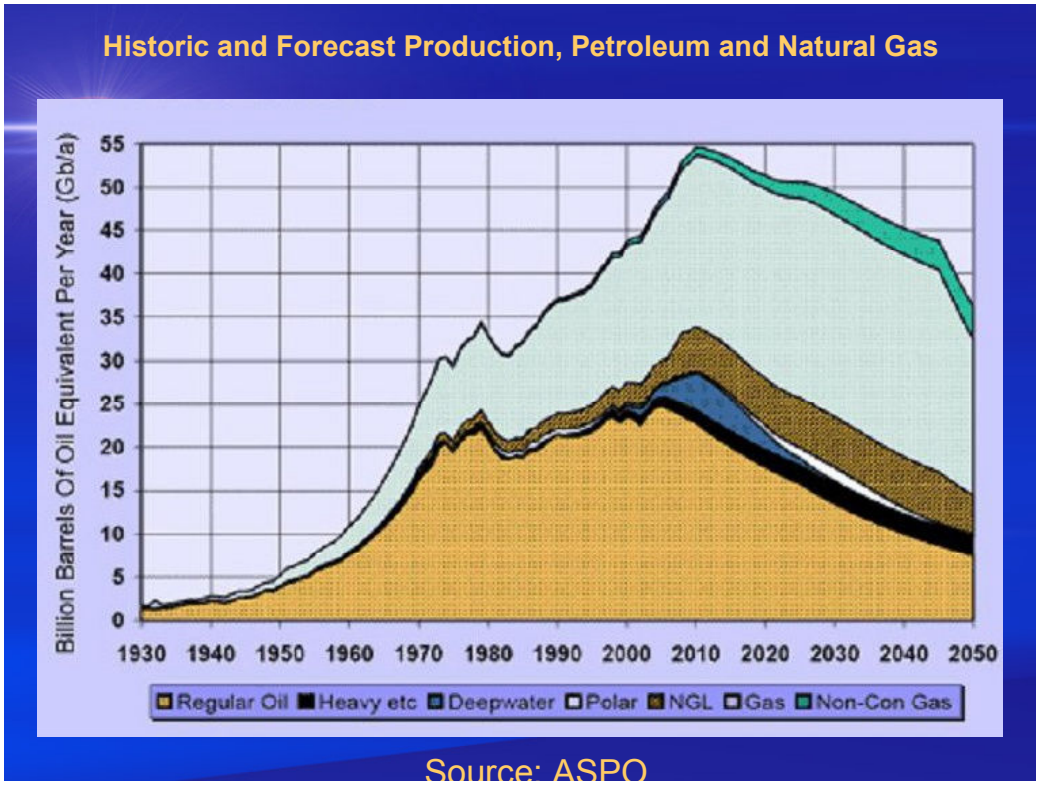
Production from the world's major private oil companies is also in decline; only a few national oil companies such as Saudi Aramco have enough excess production capacity to offset declines elsewhere. Much of the maintenance of reserves by the private companies is through acquisition, not discovery.



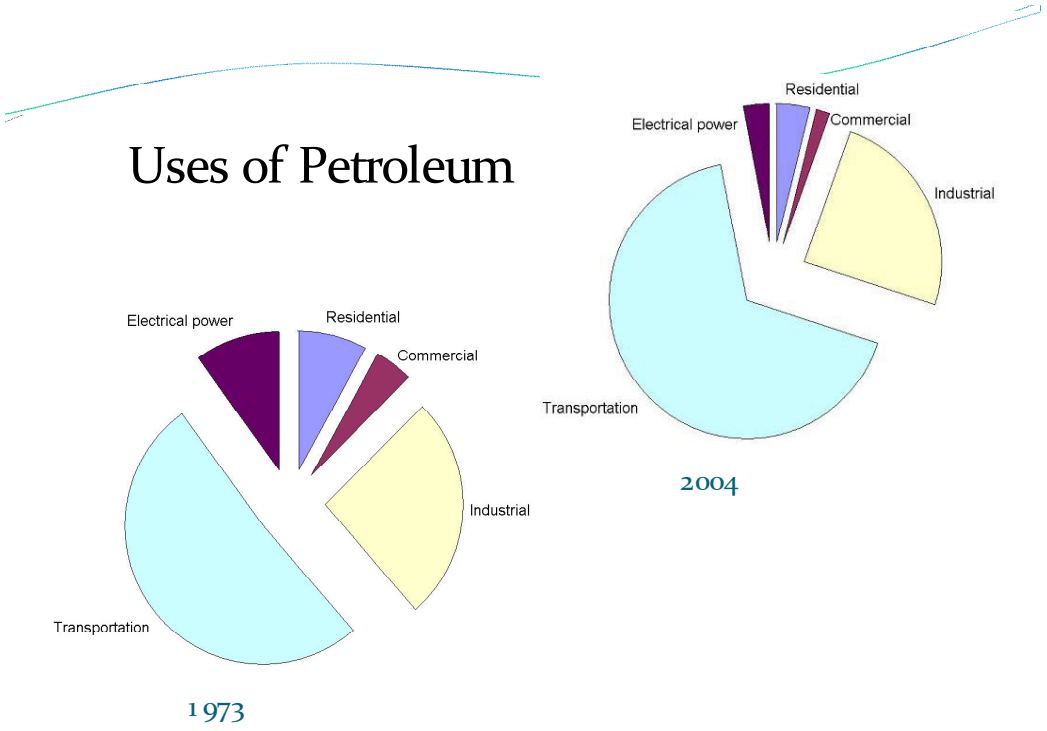
Given this information as context, some major oil companies are quite direct in describing the coming energy challenge, as with Chevron advertisements that state, “The world consumes two barrels of oil for every barrel discovered – so is this something you should be worried about?”, and “It took us 125 years to use the first trillion barrels of oil; we’ll use the next trillion in 30.”



A graphic depiction of the decline in worldwide conventional petroleum production was provided as early as 2000 by US Geological Survey Open File Report 00-320, available online.



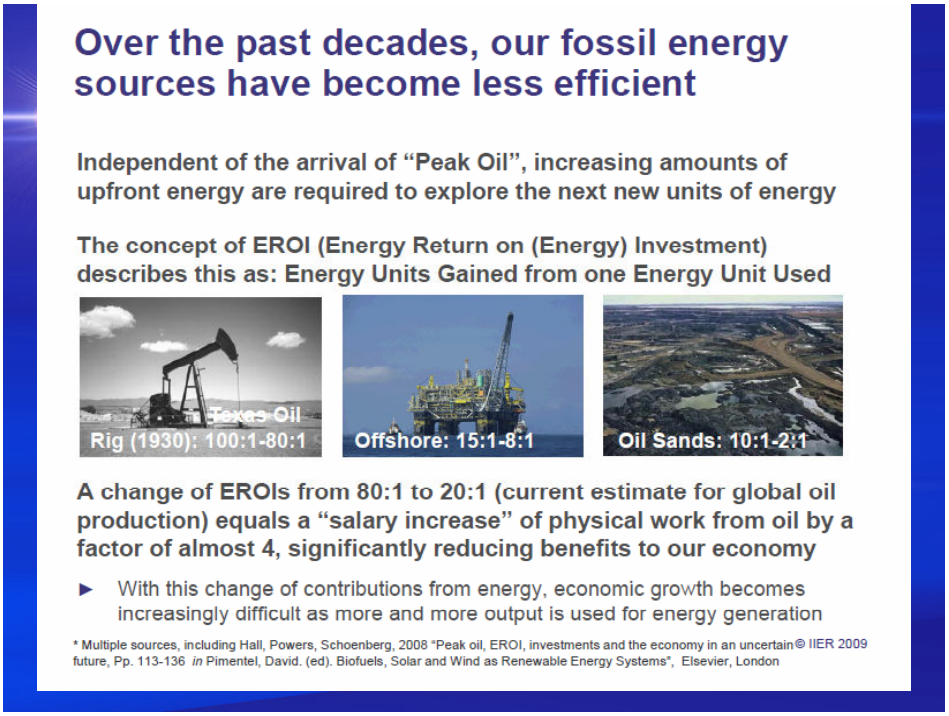
Of more value is a similar graphic prepared by the international Association for the Study of Peak Oil, which arrays production forecasts for heavy, deepwater, and polar petroleum resources atop conventional oil production, as well as providing a depiction of forecast natural gas and natural gas liquids production. From this it can be seen that even as production of petroleum and other liquid fuels declines in the near future, natural gas production including substantial resources in the United States can remain reasonably constant for about 30 more years.



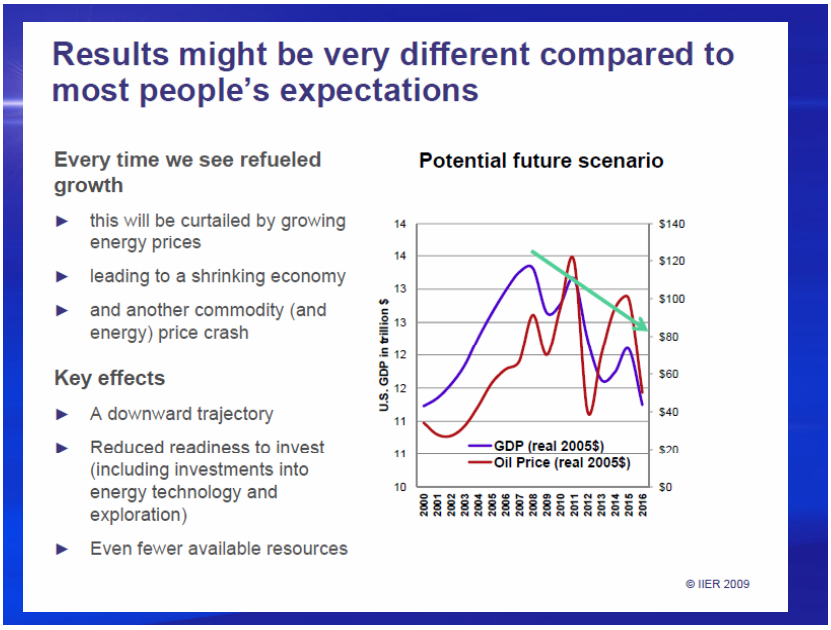
The impact of the petroleum shortfall will be greatest in the transportation and in industrial uses such as manufacture of fertilizers and pesticides for food, and in pharmaceuticals. Natural gas has gradually replaced oil for heating and power generation. Thus, the outlook for supplies of electricity over the next several decades appears much more bullish than the outlook for gasoline and diesel powered vehicles. Natural gas supplies are limited as well, however, and this temporary availability should viewed as a bridge to an era of production of electricity from other, hopefully renewable sources.

Among the reasons that peak oil seems to be poorly understood and underreported is that much of the discourse seems to emanate from economists used to supply-demand-price relationships in which excess demand results in a price increase, which in turn results in more supply. Supply is viewed merely as a function of price. In the case of non-renewable resources such as fossil fuels, however, not only does increased price not create more product, but the average upstream cost is continually rising as depletion requires more energy intensive production from deeper and lower

quality resources. Among the best analysis of this is provided by the Institute for Integrated Economic Analysis in Switzerland.



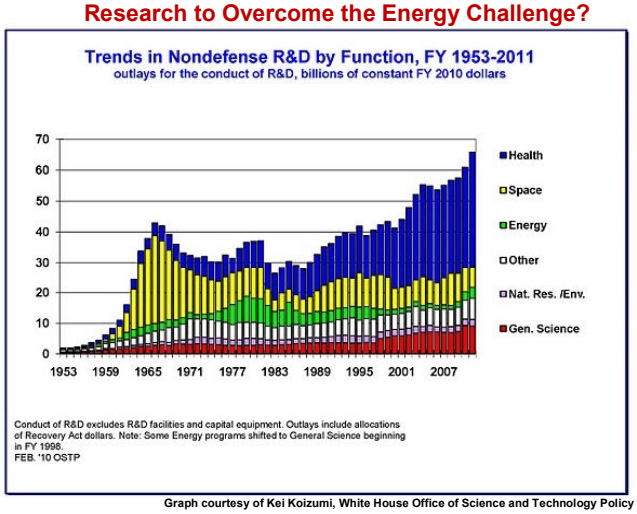
Ultimately, the cutoff is likely to be determined as much by the energy return on energy invested; as the amount of energy required to produce, refine, and sell the product approaches the amount of energy contained within it, its value as a fuel shrinks accordingly. Not shown here, but included in this research, is information indicating that none of the renewable technologies known today approach the energy returns enjoyed in the earlier days of petroleum production; it seems very unlikely that mankind will ever again have access to what were at least perceived as limitless, nearly free supplies of energy.



Another criticism of economists is the attribution of the experience of 2008, in which the price of oil rose to over $140 a barrel in July only to retreat even more quickly as the international economy crashed, exclusively to the bursting of a speculative bubble. In fact, the price retreat coincided with an unprecedented level of recessionary destruction of demand while supply remained remarkably constant. Only now is worldwide demand beginning to inch upward again, and as I write this petroleum prices have passed $90 a barrel for the first time since 2008. Absent any real ability to increase supply, prices will continue to rise with economic recovery until energy costs themselves limit economic activity. So it appears that given the current state of transportation and industrial technology, energy will impose an ever-more-restrictive governor on the speed at which the economic engine can rev until either supplies of high return on investment energy are increased, or civilization becomes much more efficient in its use of the available energy.

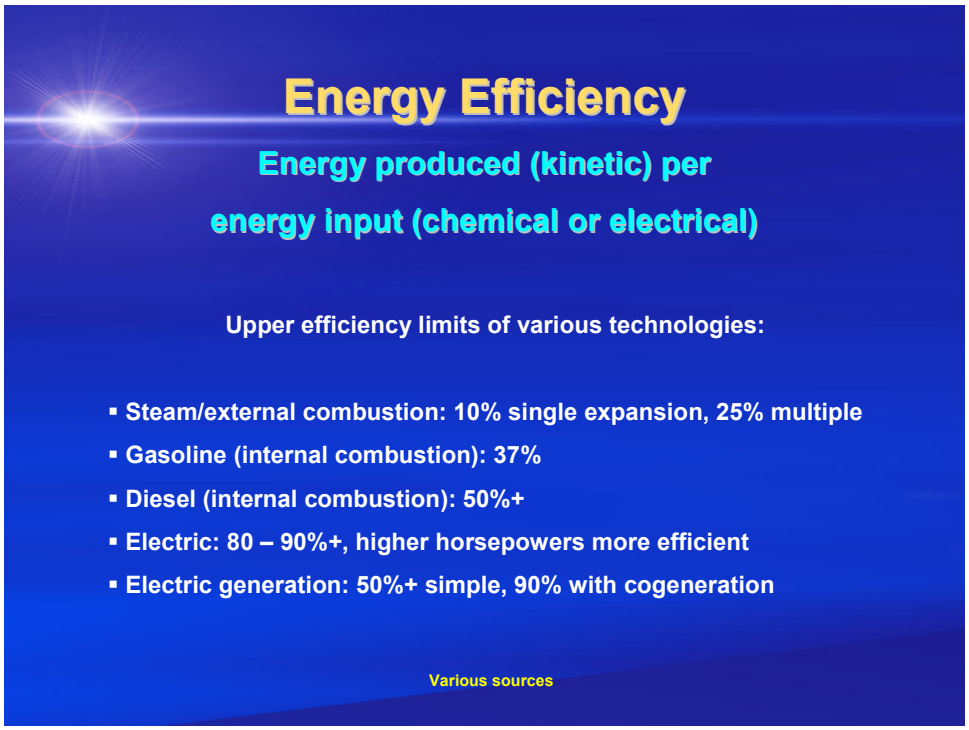
Elements of the US Department of Defense Joint Forces Command's Joint Operating Environment (JOE) for 2010 summarize the energy outlook rather well: "*To generate the energy required worldwide by the 2030s would require us to find an additional 1.4 million barrels [or petroleum equivalent] per day (MBD|) every year until then. During the next twenty-five years, coal, oil, and natural gas will remain indispensable to meet energy requirements. The discovery rate for new petroleum and gas fields over the past two decades (with the possible exception of Brazil) provides little reason for optimism that future efforts will find major new fields… By 2012, surplus oil production capacity could entirely disappear, and as early as 2015, the shortfall in output could reach nearly 10 MBD. Energy production and distribution infrastructure must see significant new investment if energy demand is to be satisfied at a cost compatible with economic growth and prosperity… Renewed interest in nuclear power and green energy sources such as solar power, wind, or geothermal may blunt rising prices for fossil fuels should business interest become actual investment. However, capital costs in some power-generation and distribution sectors are also rising, reflecting global demand for alternative energy sources and hindering their ability to compete effectively with relatively cheap fossil fuels.* ***Fossil fuels will very likely remain the predominant energy source going forward."***

Research to Overcome the Energy Challenge?



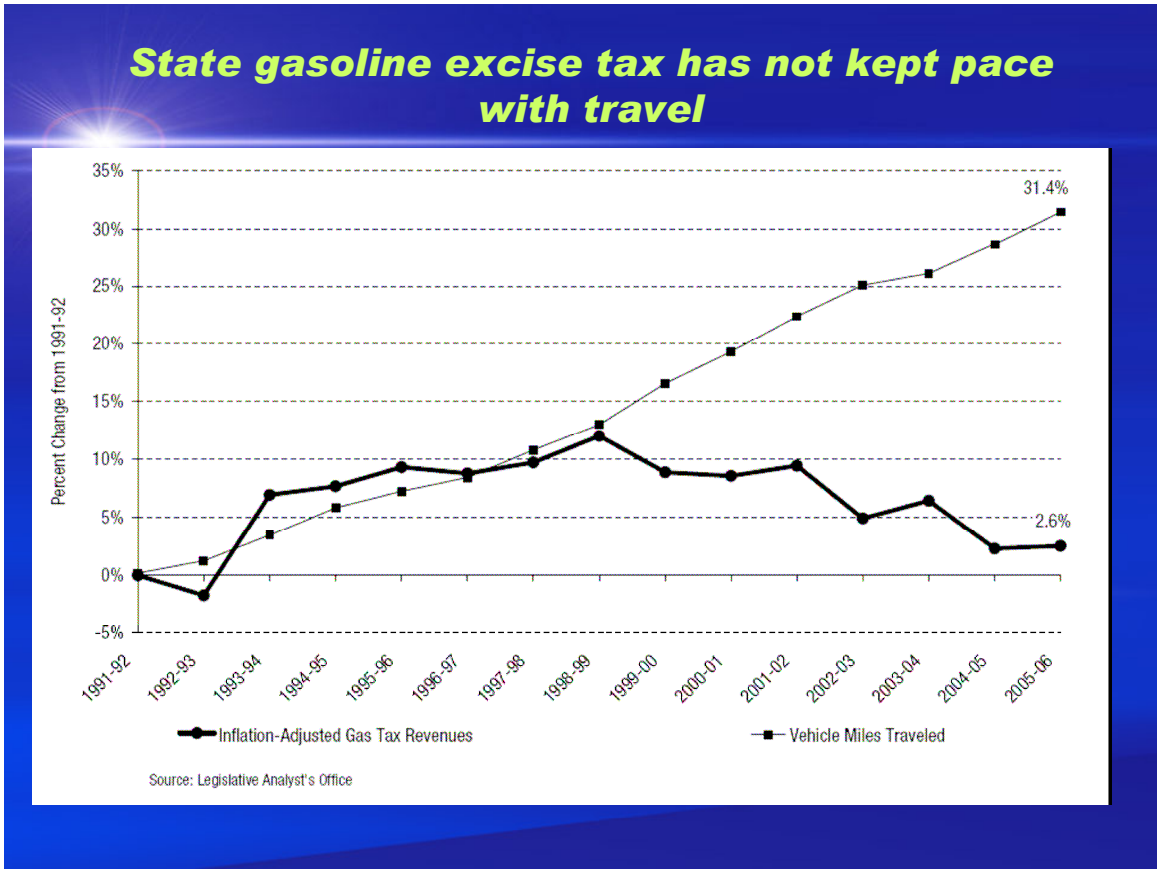
Graph courtesy of Kei Koizumi, White House Office of Science and Technology Policy

It's interesting to note that despite the seriousness of this issue, public sector funding of research and development in this area, shown here in green, continues to lag behind every other nondefense area except the environment, according to White House data from early 2010.

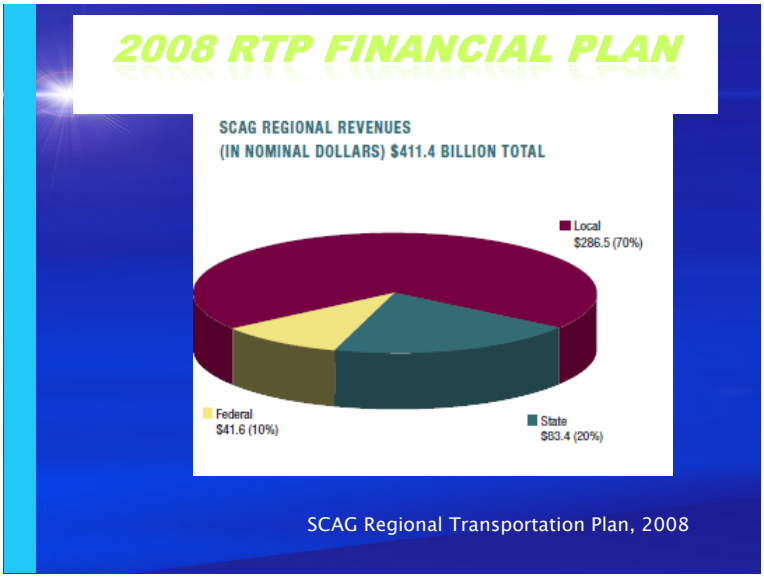


Given these circumstances, it appears that much of the strategy going forward must focus on the demand side of the energy equation, with particular attention to efficiency within the transportation sector, among the largest and least efficient consumers of energy. Quite clearly, evolution away from the relative inefficiencies of external and internal combustion power to highly efficient electric power is critical, though complicated by the need to be efficient and sufficient in generation of electricity, provide adequate transmission capacity, and avoid transmission loss as a function of distance. Preliminary data from work by Edison and the South Coast Air Quality Management District indicate that the region has about half the supply and inadequate transmission capacity at present to support full electrification of our transportation system. Transmission loss as a function of distance reinforces the need for a "distributed" generation system in which many small sources feed the grid, rather than heavy reliance, as today, on electricity imported from Nevada and Arizona to power Southern California.

Funding of regional solutions is another issue that could consume several Fortnightly papers. The following touches on only one of the many arenas in which funding is generally recognized to be inadequate - transportation – but I believe certain points are transferable to other issues.



Clearly, the gas tax that supported most historic public investment in transportation has been insufficient even to maintain and operate the system we already have for a number of years – in fact, investment in operation and maintenance of the state highway system in California has been about 50 cents on the dollar of identified need for several years now. Instead of paying for adequate O&M with gas tax revenues, we pay for its inadequacy with accidents and car maintenance bills.



There has also been a de facto transfer of responsibility for transportation funding from federal and state levels in the past, to the local level today. This is particularly troublesome in Southern California, where congestion in many key corridors and much of the road damage and repair cost, and air pollution, relate to international and interstate commerce, both of which are federal responsibilities. Transportation sales taxes like Measure I here in San Bernardino County are now the largest single source of transportation revenue in Southern California, but should not be relied on the address federal responsibilities.

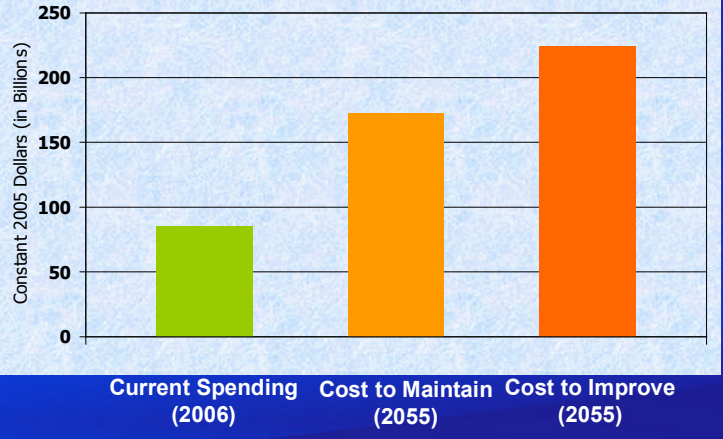
Perhaps the most objective assessment of where we stand nationally on transportation funding, and a clear articulation of where we ought to be, was provided by the Section 1909 Commission established by the Safe, Accountable, Flexible, Efficient Transportation Equity Act, a Legacy for Users, otherwise known as SAFETEA-LU.

Findings of the Federal 1909 Commission

Current Funding for Capital Expenditures by Source and Mode

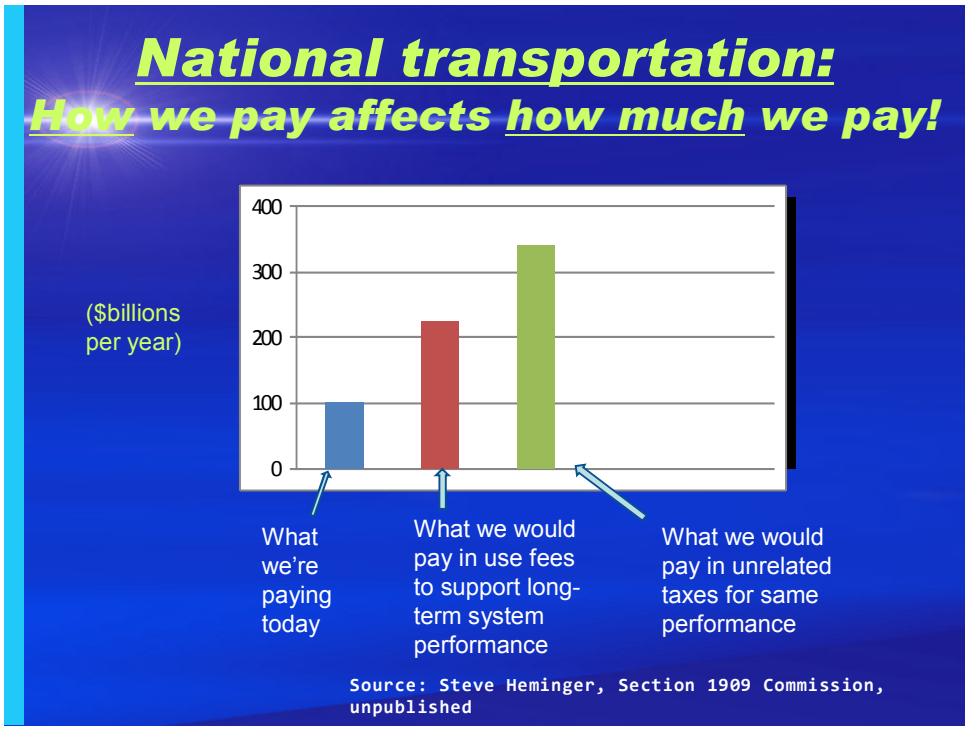
	Highway	Transit	Intercity Pass Rail	Freight Rail	All Modes
Total Funding	75.1	11.8	0.6	13.8	102.7
Federal	32.1	4.6	0.5		38.4
State and Local	37.7	7.2	0.1		46.6
Tolls/Private	5.4			12.4	17.8

- Public trans spending <$100B
- Should be spending $225B to meet long-term needs
- Federal share should be historic 40% (currently 17% of $225B)
- But failure to maintain fee-for-use financing (eg. gas tax) will increase cost to improve to >$300B

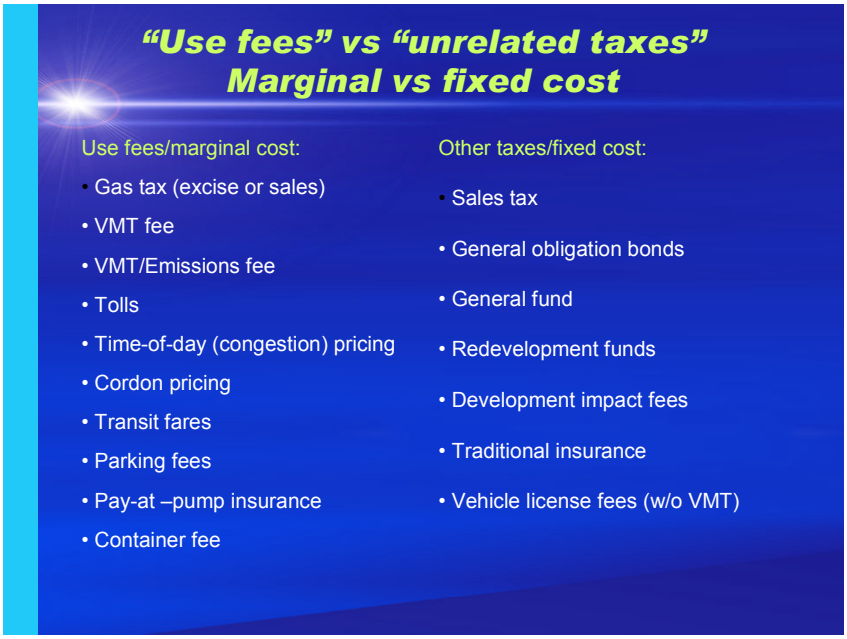


This blue ribbon panel of public and private sector transportation experts, supported by US Department of Transportation staff, concluded that while combined public and private investment is slightly over $100B per year nationally, about $170B per year is needed just to adequately maintain and operate the existing system over the long term, and about $225B per year is needed to adequately support a reasonable level of long-term economic growth. They also noted that the appropriate federal contribution to the funding total, given the federal responsibility for international and interstate commerce, is about 40%, or double today's federal

contribution. To support this, the panel recommended a gas tax increase of up to 40 cents per gallon. This received the same welcome in Washington as the recent deficit reduction package. Lost in the furor over the proposed gas tax increase, however, was a potentially more critical finding that the cost of the transportation system depends in part on how we pay for it!



In other words, the level of system quality that would be supported by investment of $225B per year in gas tax or other "fee for use" revenue sources, could instead cost us more than $300B per year if we insist on paying for it in ways that are perceived as fixed rather than marginal costs, or that have no reasonable nexus to use of or benefit from the transportation system so as to affect demand.

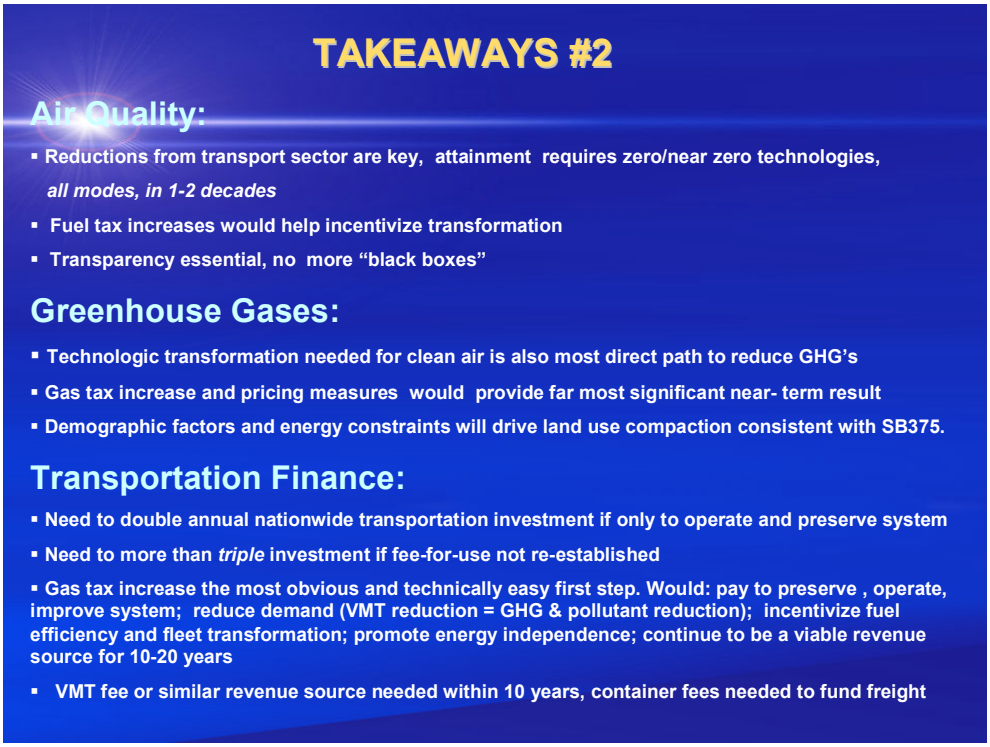


In reviewing the funding sources in use or under consideration for transportation, it is indeed remarkable how consistently funding sources unrelated to transportation use or benefit – the right column in this graphic - are chosen, absent any recognition that in so doing, we're relegating ourselves to either a higher cost, or more likely, an even less adequate transportation system. This line of argument usually leads to expressions of concern over social equity and progressive versus regressive taxation, but mercifully I'll spare you that discussion in the interest of time. Here, as in the case of greenhouse gas reduction strategies, how we price individuals' contribution to congestion – or emissions – matters; as an esteemed colleague of mine once said, "bad prices will defeat good planning every time." In closing, let me whisk you back through points touched on in this paper:

From the demography we can expect continuing reductions in average per capita income tax and sales tax revenues, an increasing demand for public services, a smaller labor force supporting increasingly large aging and young dependent populations, a growing need for safer transport alternatives, an increased demand for small lot detached and attached residences, and little demand for new "suburban style" development.

In the area of transporting people and goods, we know we'll have 5 million more people to move, yet most (90%+) of our 'future' infrastructure is here today. This calls for maximizing the utility of our existing infrastructure – a topic in itself. We expect to see a market-driven trend toward compaction of both residential and non-residential uses driven by increasing transport costs. Despite the recession, we still expect a doubling of freight in within 25 years, and need dedicated clean technology freight corridors both to maintain personal mobility and safety, and to achieve healthy air quality.

With respect to energy, petroleum production is expected to decline significantly within this next decade, but natural gas production can be maintained at current levels for two or more decades. We will see significant near-term reductions in Energy Return on Investment from fossil fuel and other energy production. We need to intensify our focus on development of energy alternatives and energy-efficient (not just fuel efficient) technologies to reduce demand, which almost certainly means electrification.

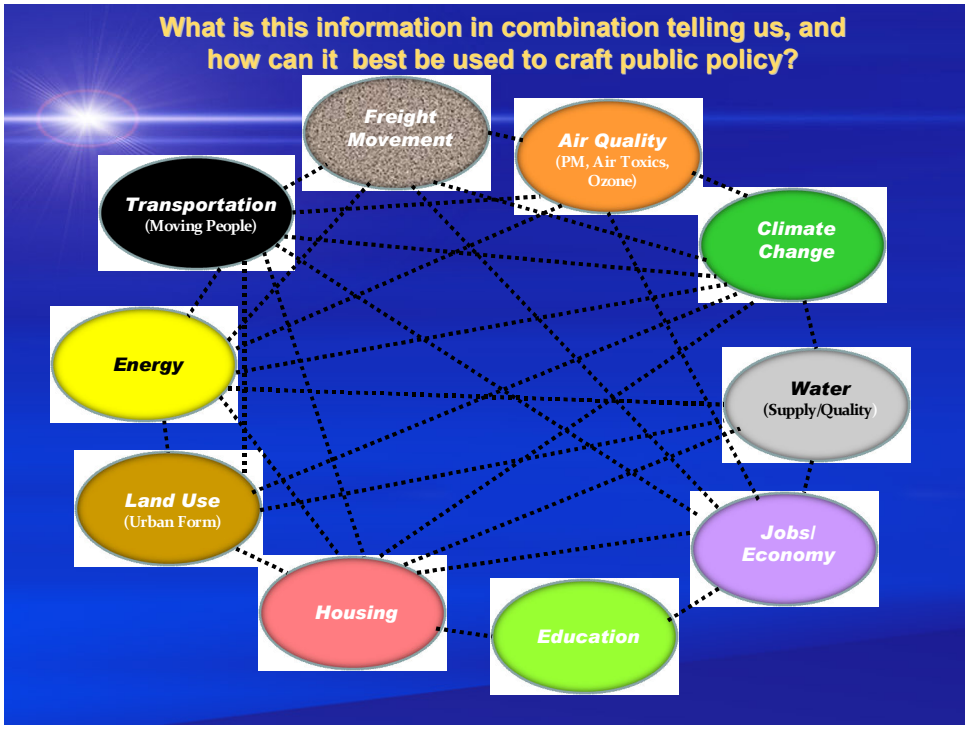


The key to the regional air quality challenge is the transport sector. Timely attainment of federal health standards will require wholesale implementation of zero emission technologies for all modes but ships and planes, and reductions from those as well, within a dozen or so years. This transformation would be incentivized through substantial fuel tax increases. In this effort, education and transparency is essential; "black boxes" are in fact counterproductive.

The same technologic transformation of the transportation sector needed for clean air is also most direct path to reduce greenhouse gases from that sector. In addition to technology, a significant gas tax increase and pricing measures would provide far more significant near-term results than the densification and transit orientation proposed by SB 375, although those strategies are in fact needed to address demographic factors and energy constraints as noted previously.

Regarding transportation infrastructure, the region and nation will need to nearly double the level of transportation investment if only to operate and preserve the system, but will need to more than triple investment if fee-for-use is not re-established as its principal financing mechanism. A

gas tax increase to adequately support preservation, operation, and improvement of the system is the obvious and technically easy first step. That same action would reduce demand, reduce emissions, incentivize fuel efficiency and fleet transformation; and thereby promote energy independence. A VMT fee or similar revenue source is needed to first augment and then supplant the gas tax within about 10 years, and container fees are needed to fund freight infrastructure.



So, in closing, I argue that demography and land use, land use and transportation, transportation and the economy, the economy and air quality, air quality and climate change, and all of the above and energy are so closely related that an understanding of one demands consideration of the others. The synergies and co-benefits among the strategies needed to address each of these issues are clear, and represent a remarkable opportunity for the region to simultaneously address many of our most serious challenges. Finally, I would further argue that this recognition is generally lacking, and that many of the questionable policy choices occurring around us at regional, state, and national levels can be attributed to …silos.