TRENDLAB+

Rethinking travel in light of demographic, economic and technology trends

Planning Horizons, February 2016

what. IS FP THINK

www.fehrandpeers.com/fpthink

FP Think is our latest initiative designed to enhance our clients' understanding of how disruptive forces in technology, demographics, and socioeconomics may affect their transportation planning decisions.

Transportation Aggregators

Electric Vehicles

Electric Bikes

Microtransit

FEHR PEERS
Improving Communities Since 1985

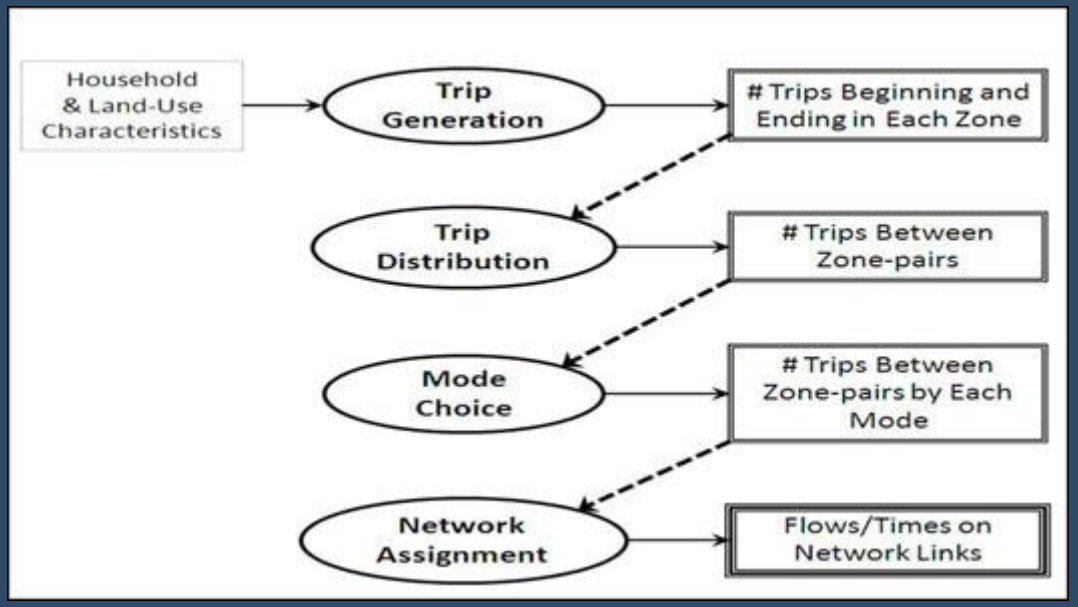
roadmap.

- Travel trends past
- Travel trends present
- Travel trends future
  - Scenarios
  - Live poll
- Closing / Q&A

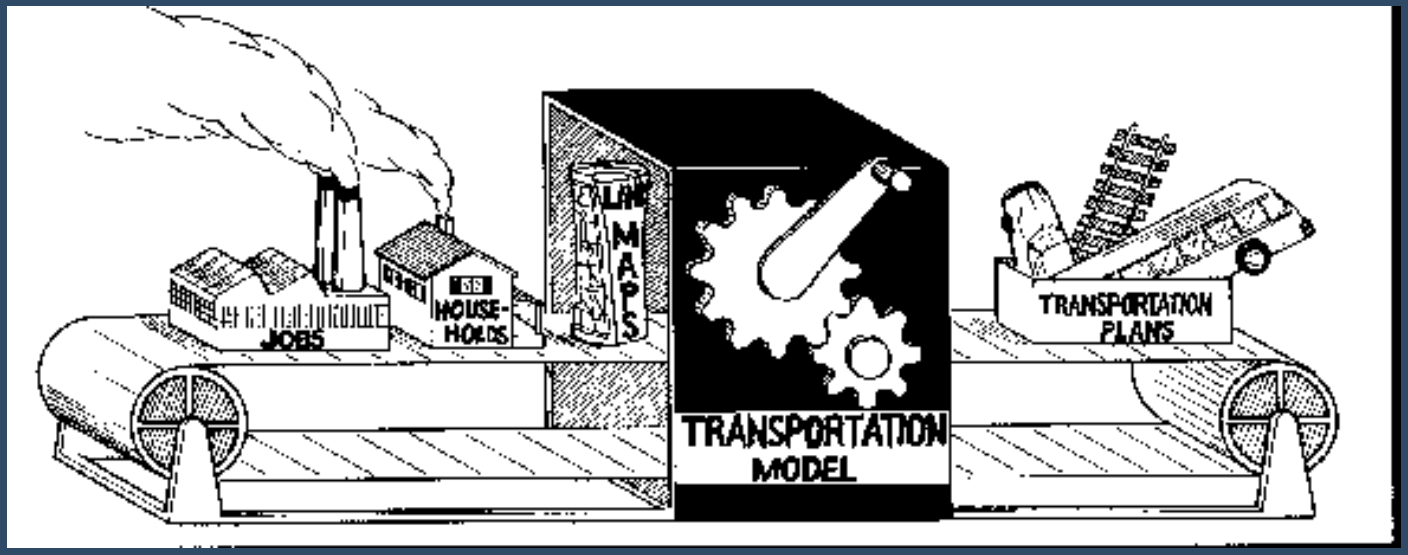
part 1. TRAVEL TRENDS PAST

models. TRAVEL TRENDS PAST

- How did we start modeling travel the way we do?



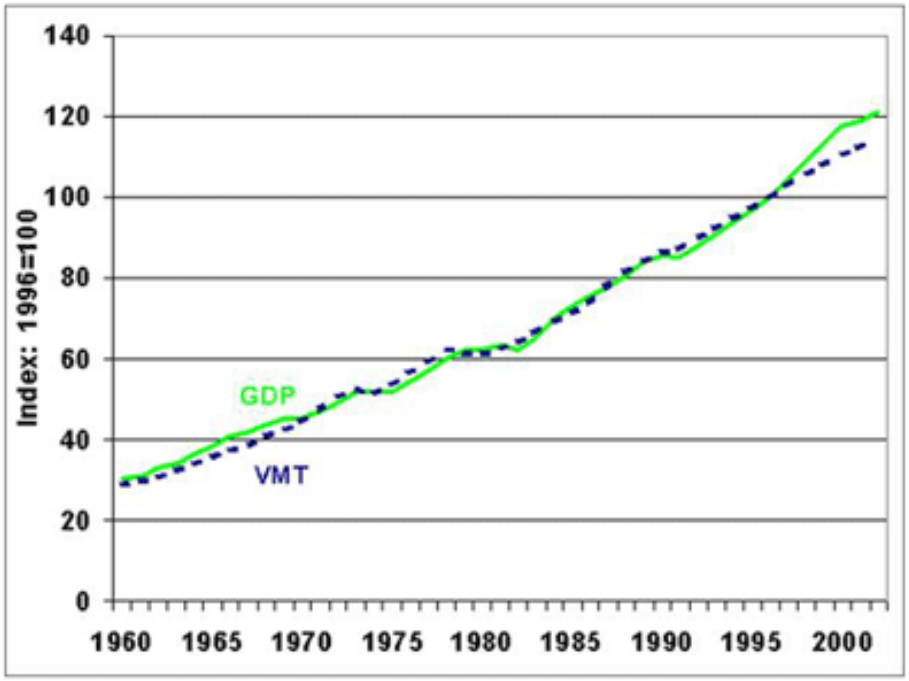
models. TRAVEL TRENDS PAST



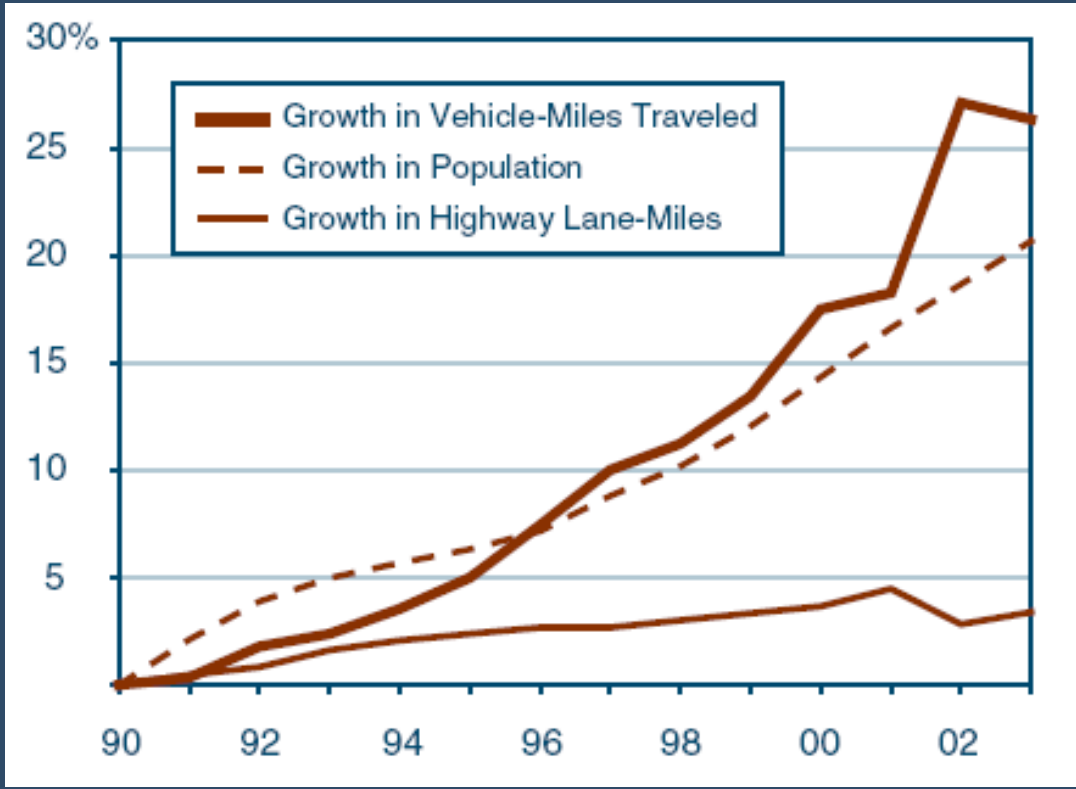
vmt TRAVEL TRENDS PAST

Fact #347: November 22, 2004
The Relationship of VMT and GDP

The nation's highway vehicle miles of travel (VMT) and the U.S. gross domestic product (GDP) reflect strikingly similar patterns, indicating the strong relationship between the nation's economy and its travel. The graph shows how closely the two data series track each other over the past four decades (Reproduced from http://www1.eere.energy.gov/vehiclesandfuels/facts/2004/fcvt_fotw347.html).



TRAVEL TRENDS PAST: CALIFORNIA



Source: CA Legislative Analyst's Office

vmt. TRAVEL TRENDS PAST

- What are the consequences?

TRAVEL TRENDS PAST

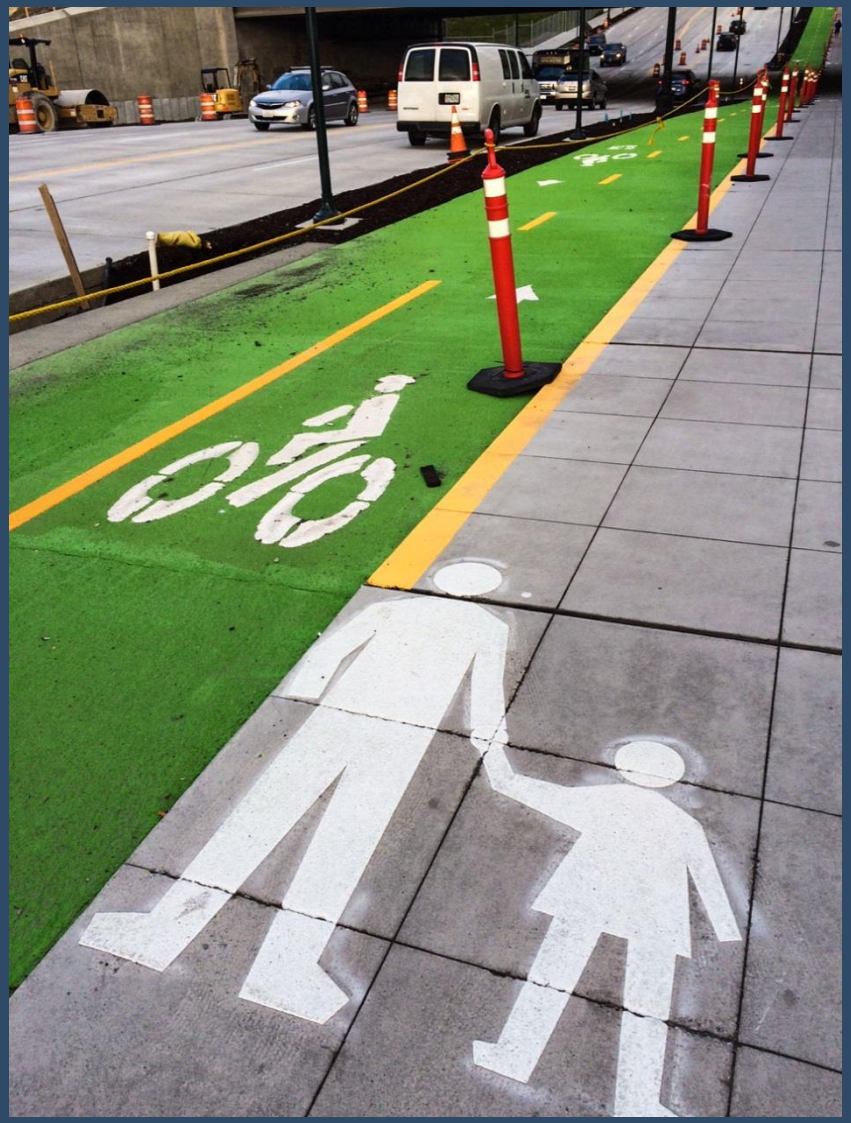
Source: Edward A. Beimborn

results. TRAVEL TRENDS PAST

"But even for roads, for half the projects the difference between actual and forecasted traffic is more than ±20%. On this background, planners and decision makers are well advised to take with a grain of salt any traffic forecast that does not explicitly take into account the uncertainty of predicting future traffic."

- Bent Flyvbjerg, Oxford University

part 2. TRAVEL TRENDS PRESENT



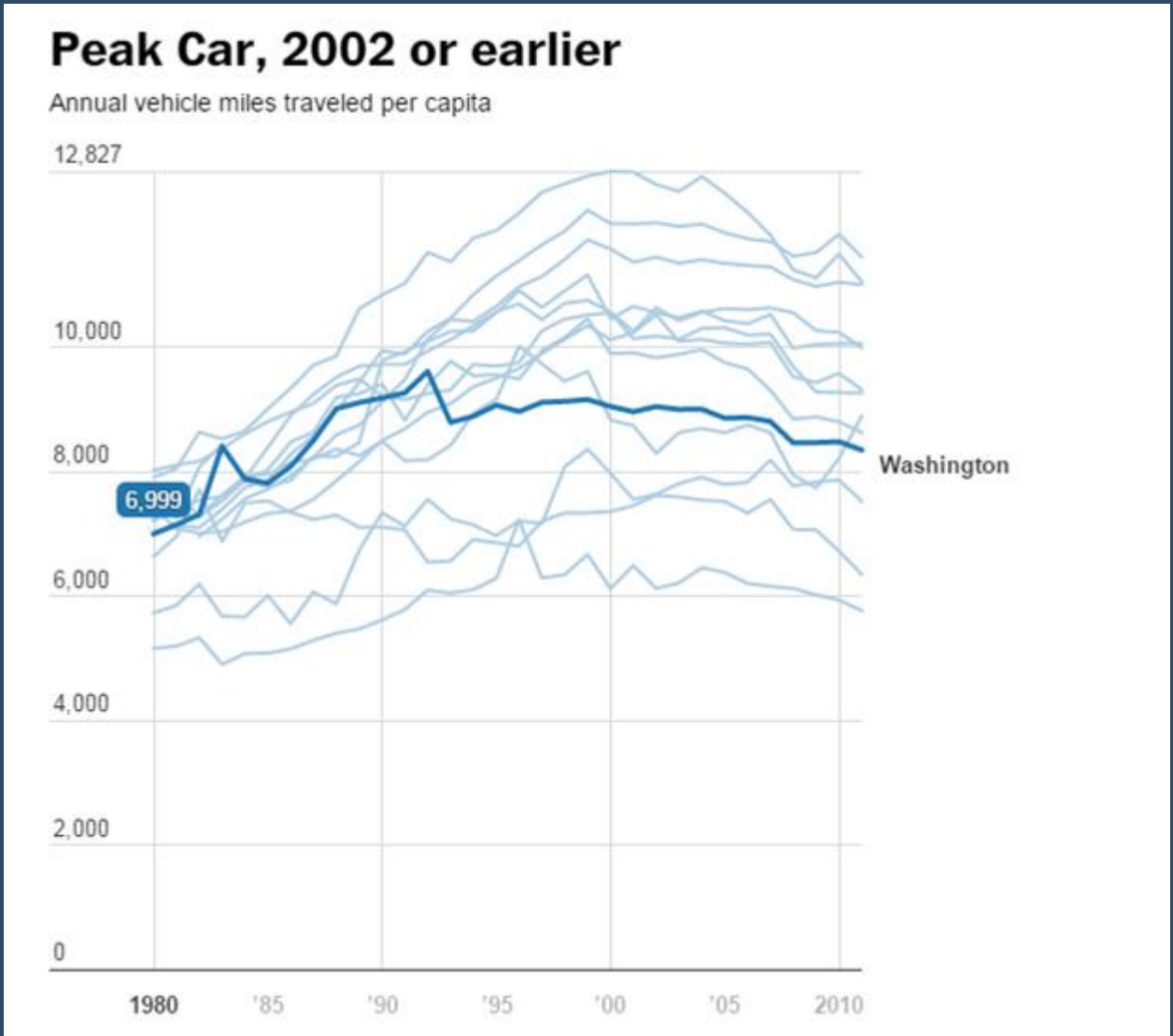
part 2. TRAVEL TRENDS PRESENT DEMOGRAPHIC & SOCIOECONOMIC TRENDS

A number of recent changes in demographics and travel choices are impacting travel

trends.

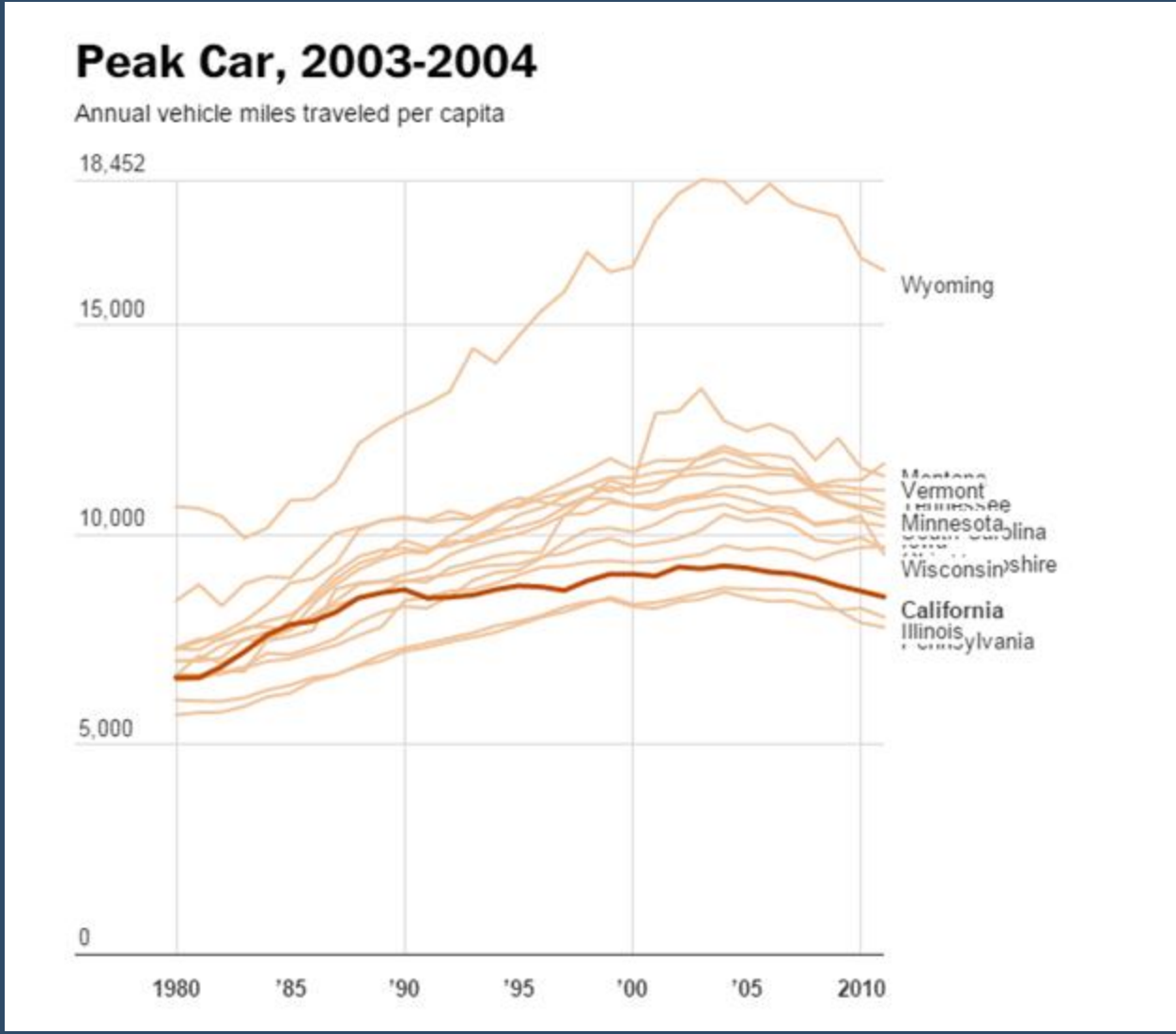
2004 DECOUPLING OF VMT AND GDP

trends. 2002 OR EARLIER VMT PEAKS BY STATE:



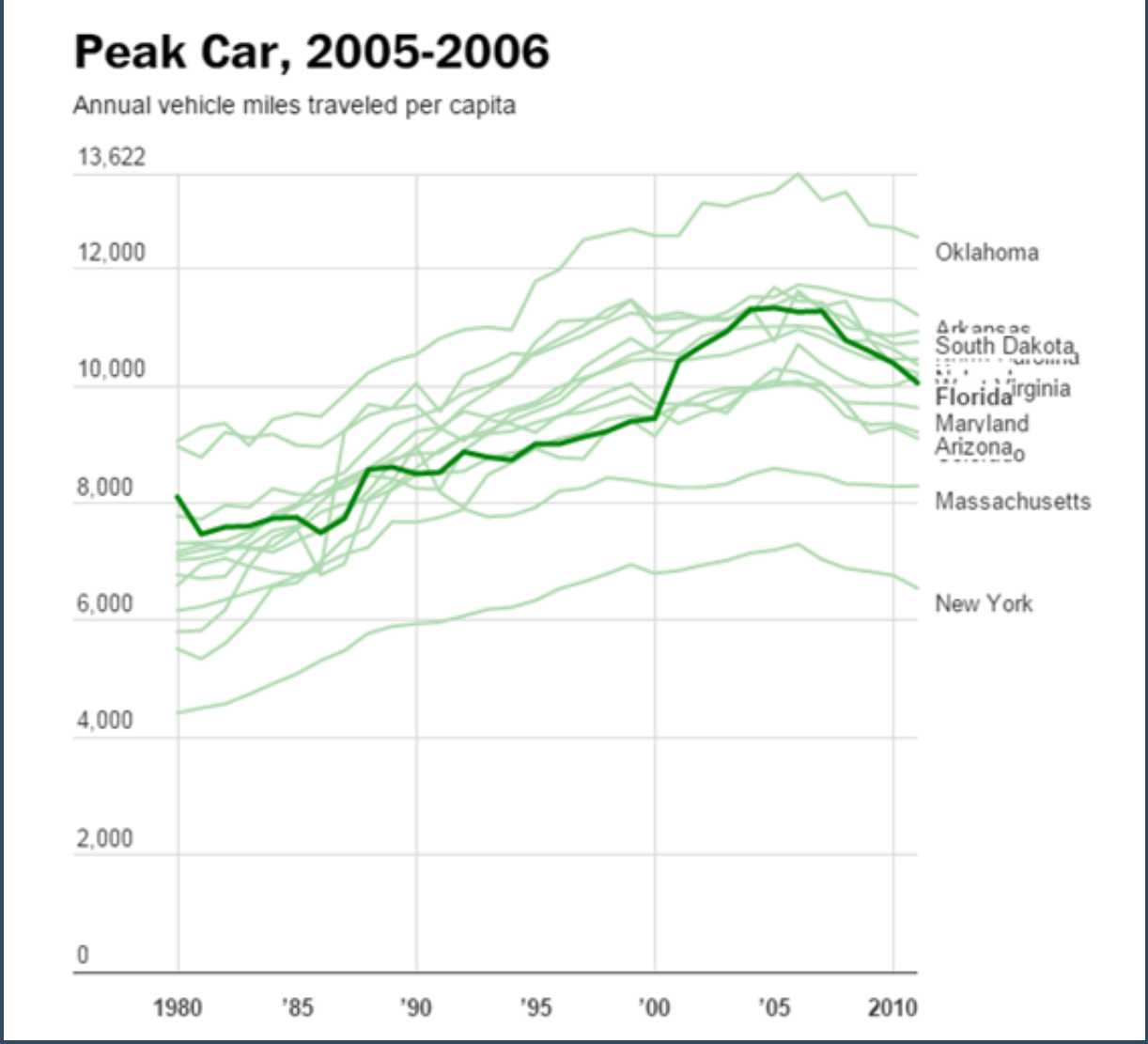
Source: Timothy J. Garceau, Carol Atkinson-Palombo, Norman Garrick, University of Connecticut

trends. 2003-2004 VMT PEAKS BY STATE:



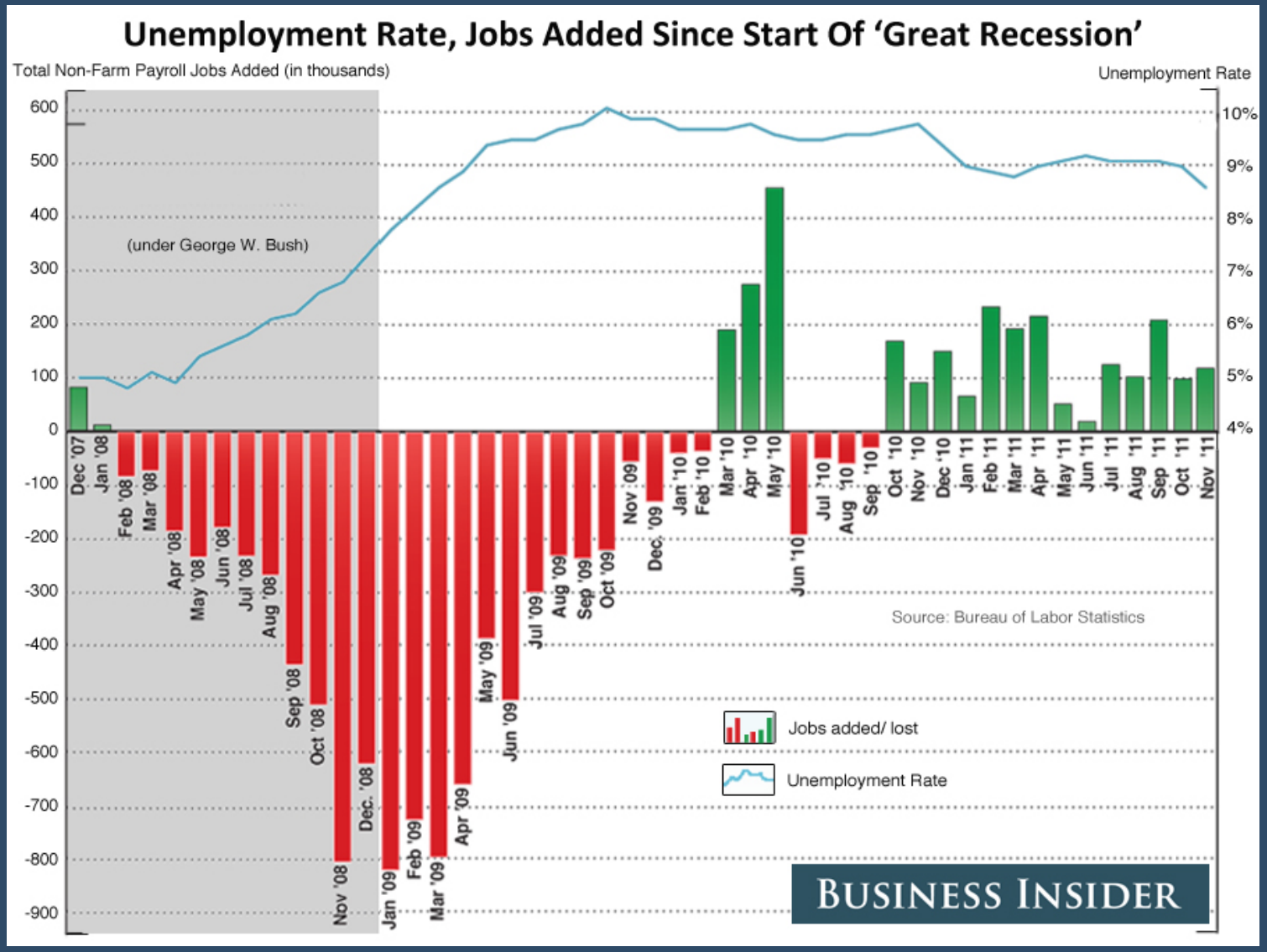
Source: Timothy J. Garceau, Carol Atkinson-Palombo, Norman Garrick, University of Connecticut

trends. 2005-2006 VMT PEAKS BY STATE:



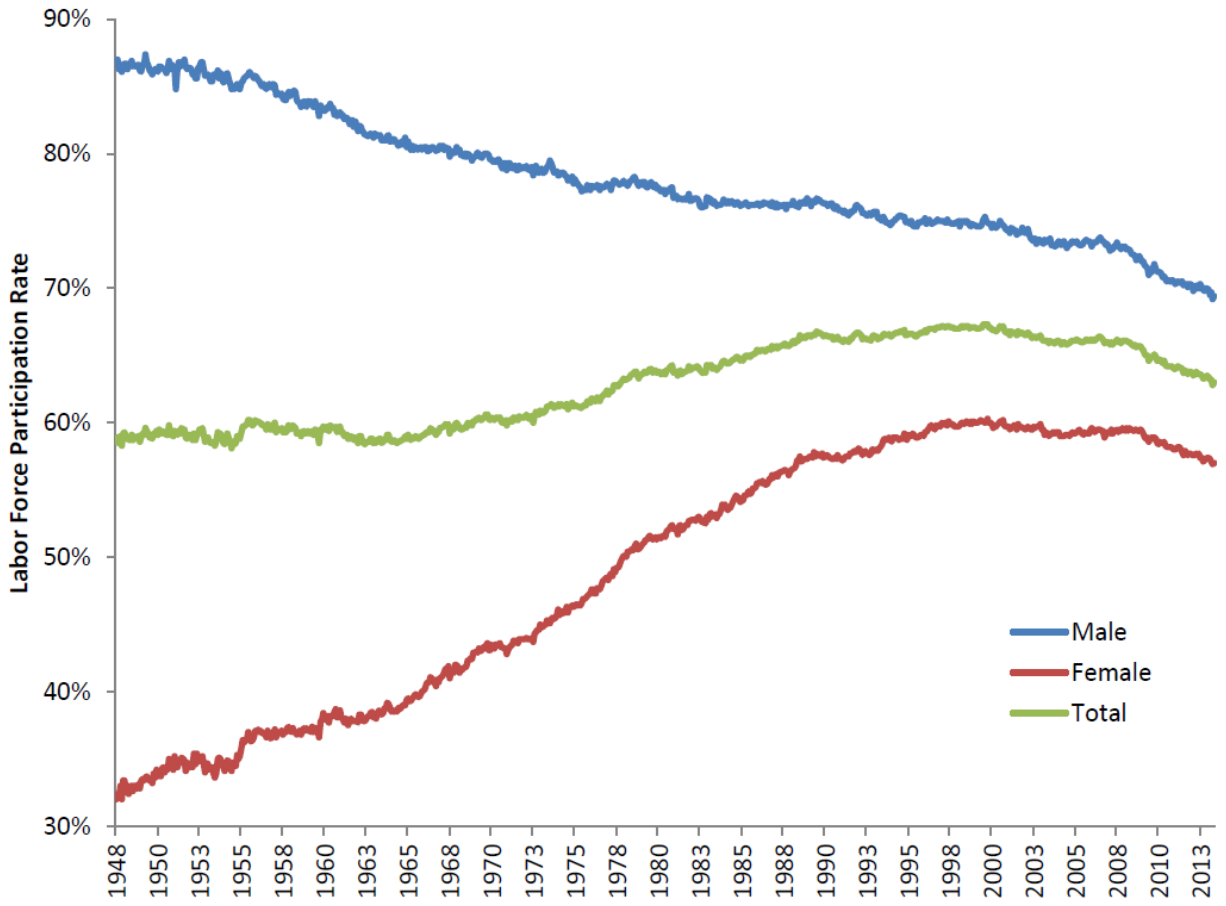
Source: Timothy J. Garceau, Carol Atkinson-Palombo, Norman Garrick, University of Connecticut

why?


Unemployment Rate, Jobs Added Since Start Of 'Great Recession'
Total Non-Farm Payroll Jobs Added (in thousands)
Unemployment Rate
(under George W. Bush)
Source: Bureau of Labor Statistics
Jobs added/ lost
Unemployment Rate
BUSINESS INSIDER

labor force.

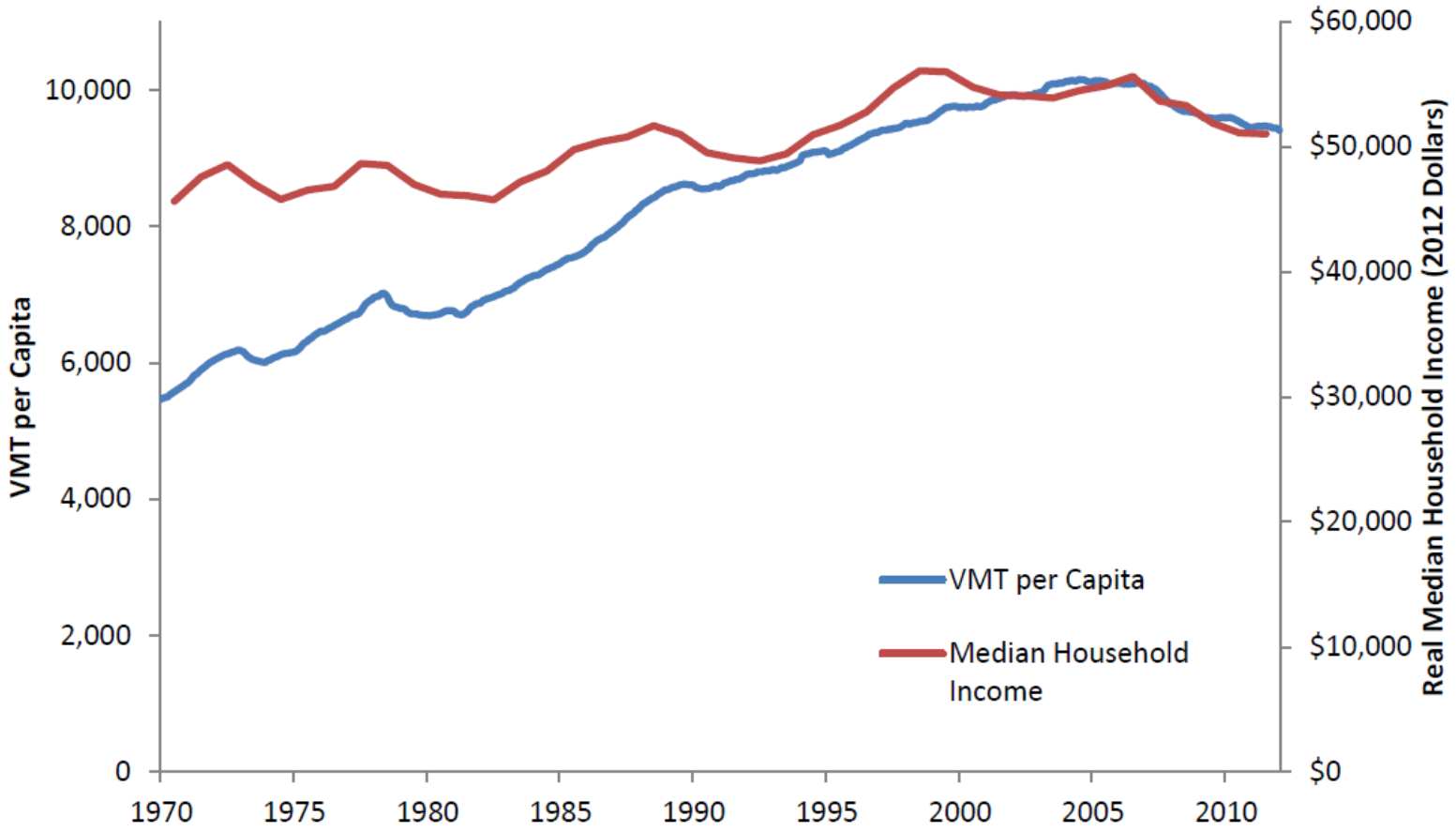
Figure 3: Male, Female, and Total Labor Force Participation Rates, 1948 – 2013



Source: Bureau of Labor Statistics.

income.

Figure 4: VMT per Capita and Median Household Income, 1970 – 2012

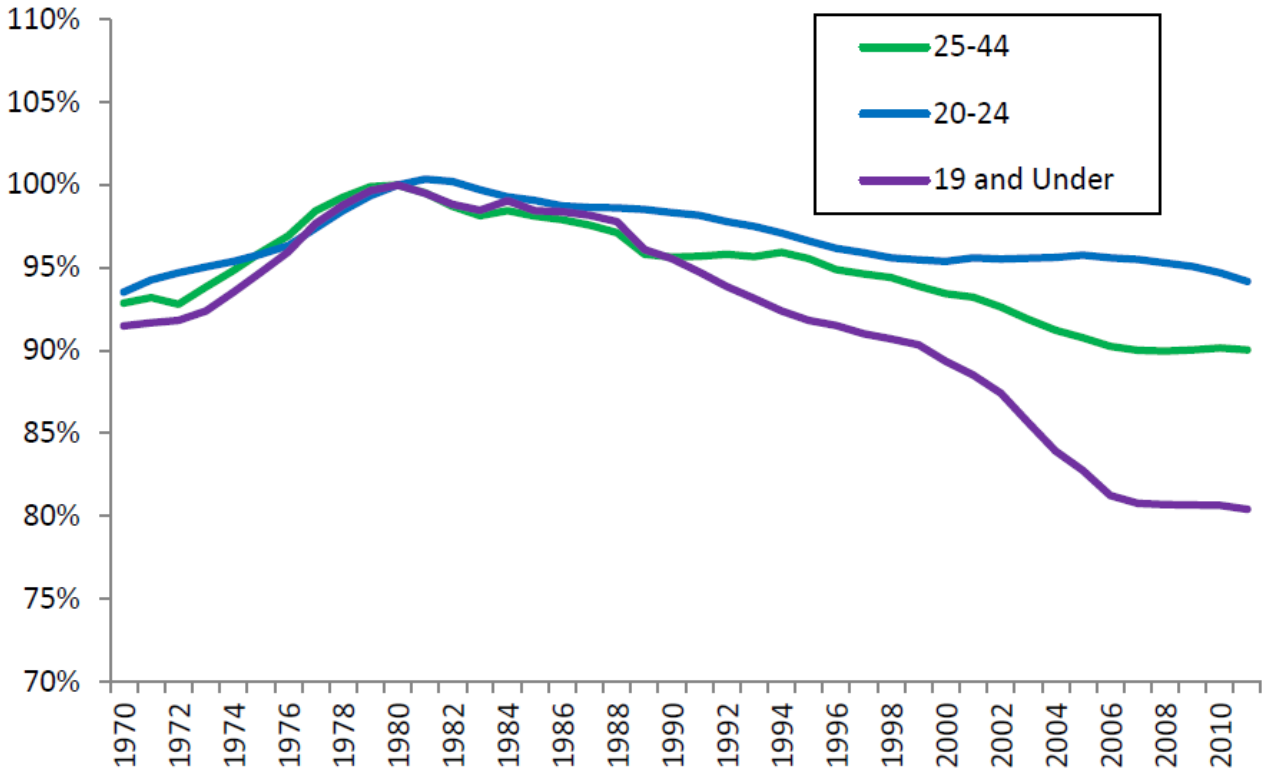


Source: Highway Administration Office of Highway Policy Information; U.S. Census Bureau.

millennials.

licensing.

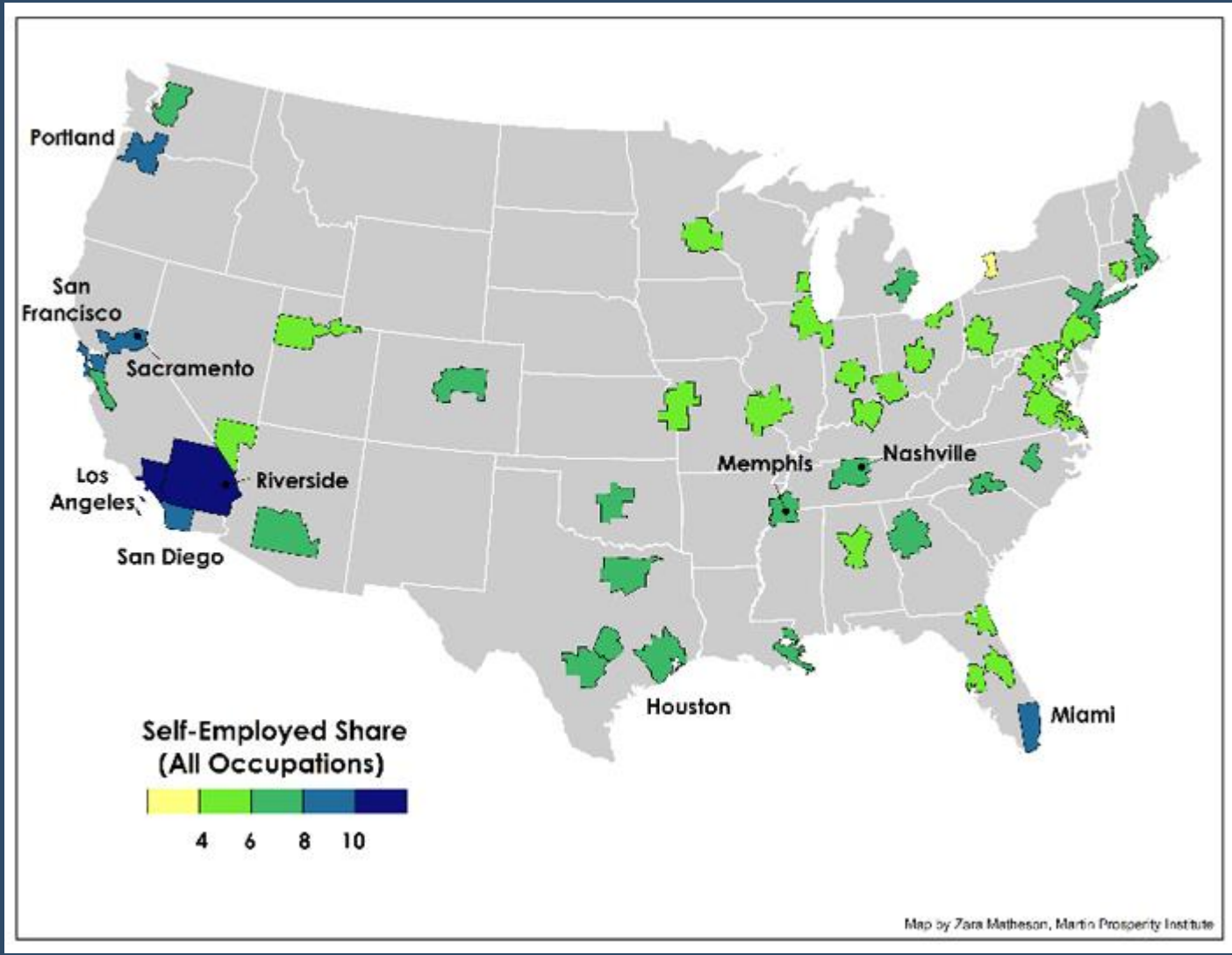
Figure 6: Index of Driver Licensure Rates by Age Cohort (Base Year = 1979). 1970–2010



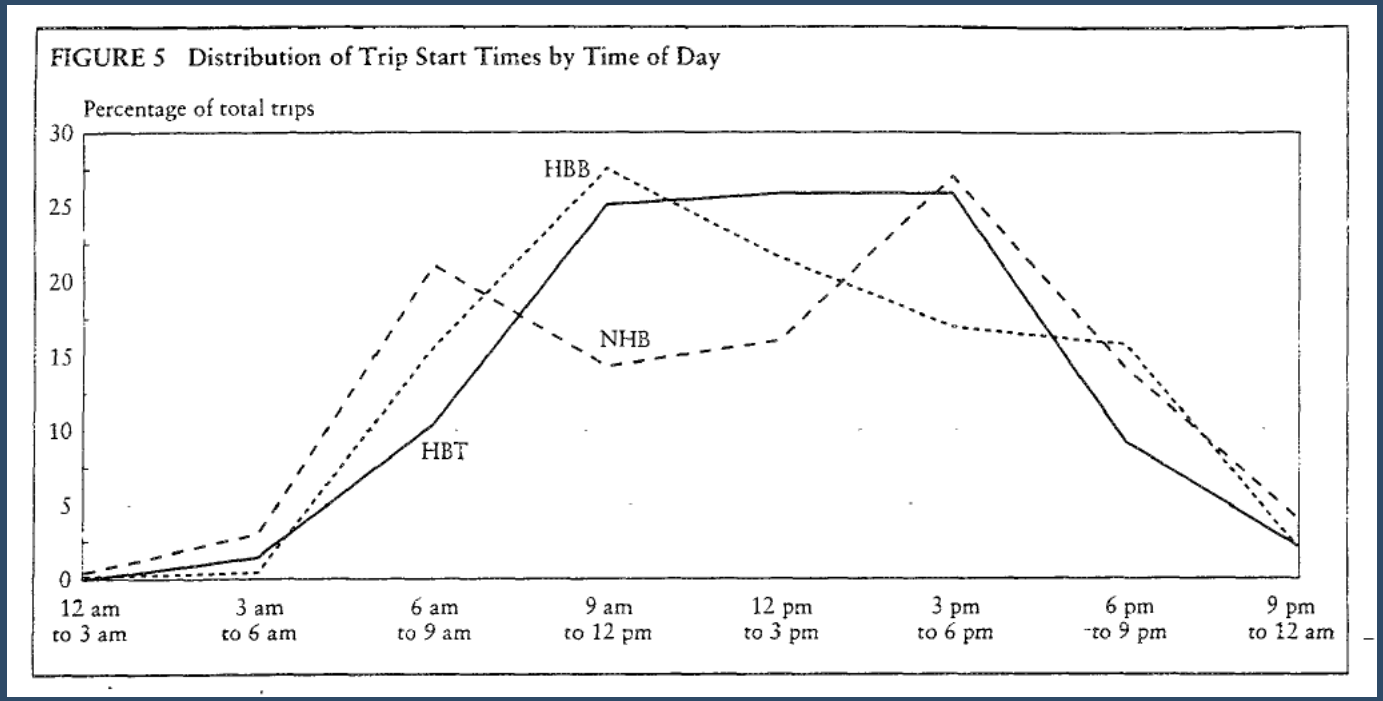
*Note: Licensure rates are the number of licensed drivers per capita, averaged over the preceding five years. The index pegs th
in 1979 to 100% and reports percentage changes. For example, if the licensure rate for a cohort were 60% in 1979 and
the 2002 value of the index would be 110%.

Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*.

freelancing.

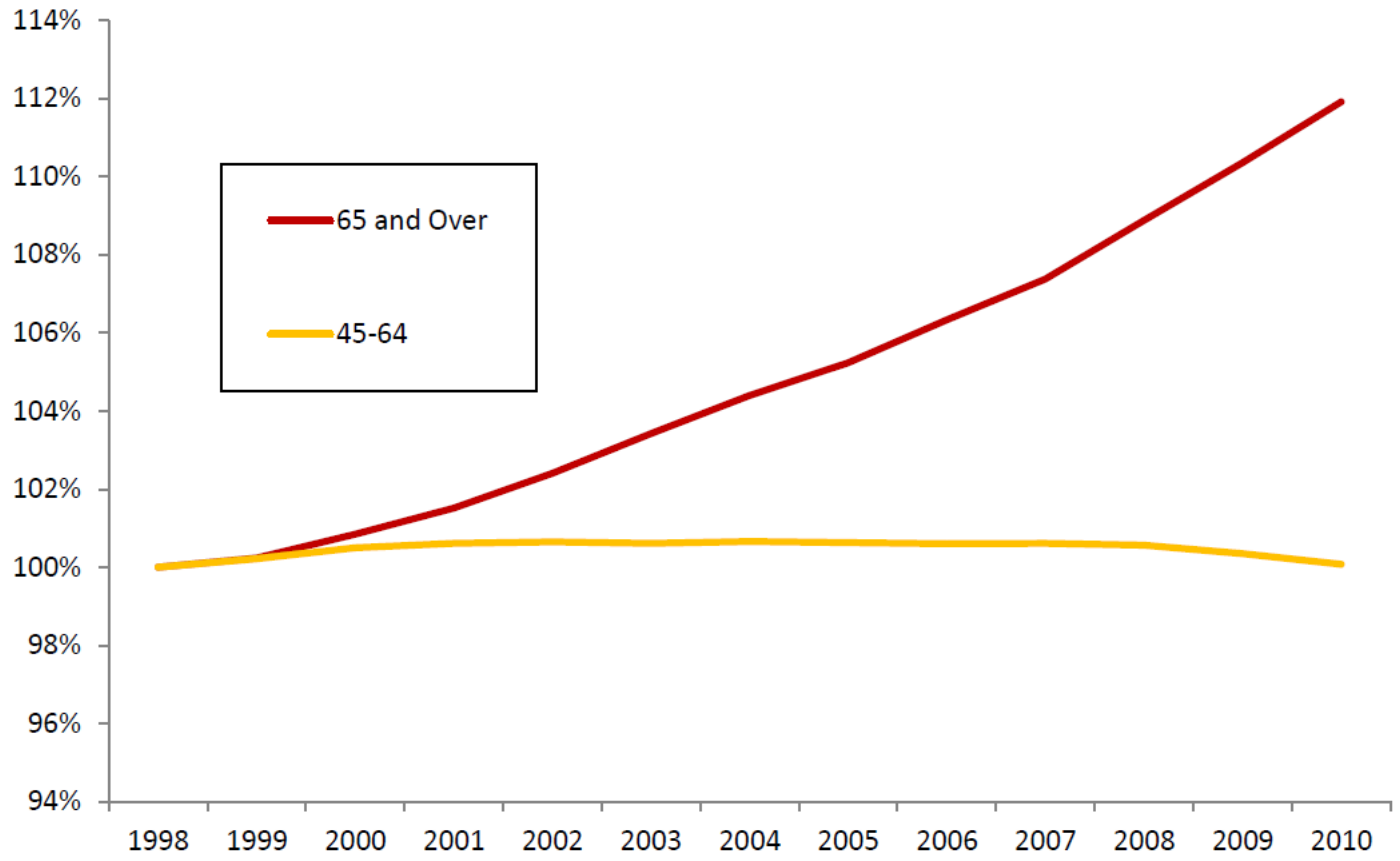


telecommuting.



age 65+ driving.

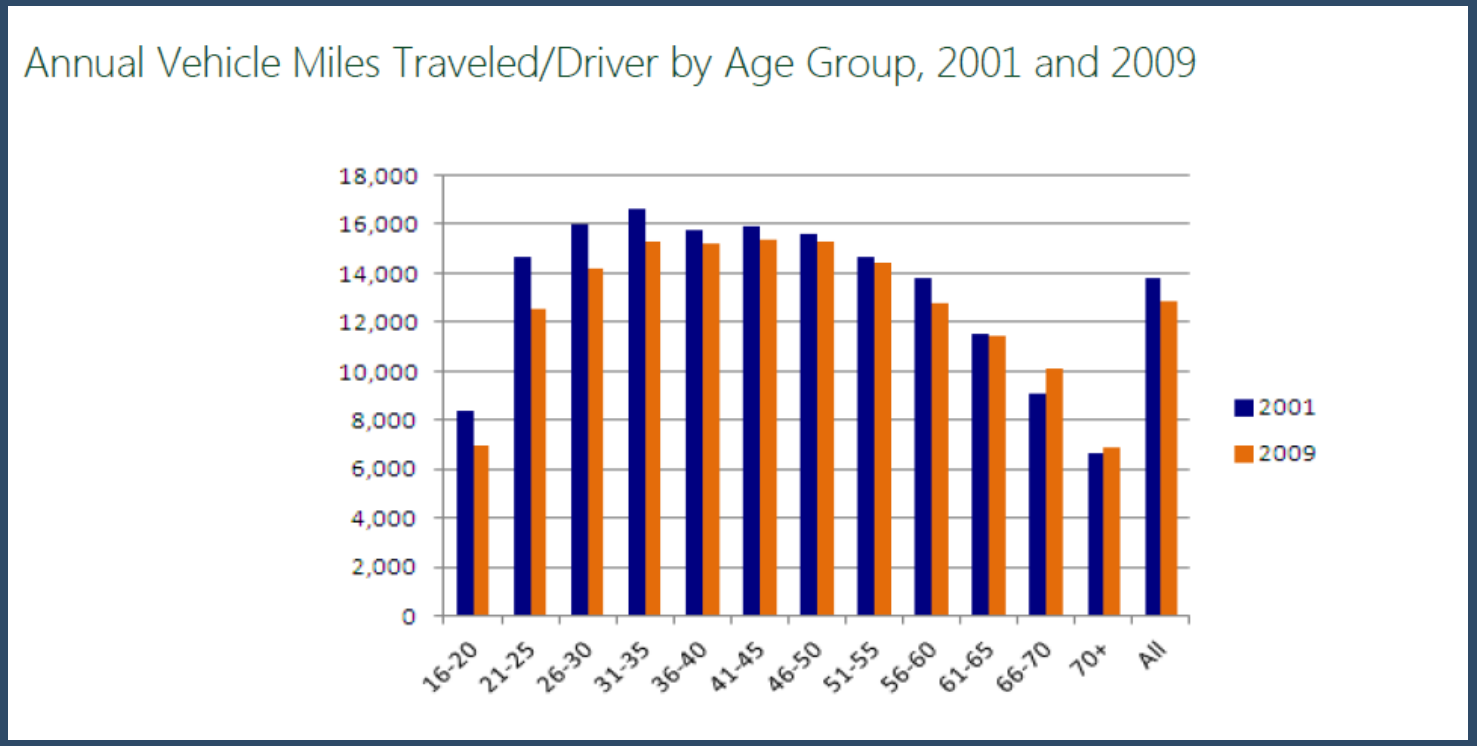
Figure 9: Index of Driver Licensure Rates by Age Cohort (Base Year = 1998), 1998–2010



*Note: Licensure rates for the 65 and Over cohort were not available prior to 1998. Licensure rates are the number of licensed drivers per capita, averaged over the preceding five years. The index pegs the licensure rate in 1998 to 100% and reports percentage changes. For example, if the licensure rate for a cohort were 60% in 1998 and 66% in 2002, the 2002 value of the index would be 110%.

Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*.
Executive Office of the President Council of Economic Advisers, *Economic Report of the President*, 2012.

VMT by age.


Annual Vehicle Miles Traveled/Driver by Age Group, 2001 and 2009
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
70+
All
2001
2009

other trends.

- Transit use, bicycling and walking accounts for only a few percentage points of the decline in VMT
- Internet shopping accounts for only about 10% of all purchases, and many purchases generate VMT increases by delivery vehicles
- Resurgence in urban living is concentrated among higher-income adults without children, while the jobs and residence locations for the rest of the population continues to disperse
- It is still not clear whether trip sharing, car sharing and short-term rentals substitute for car ownership or supplement it

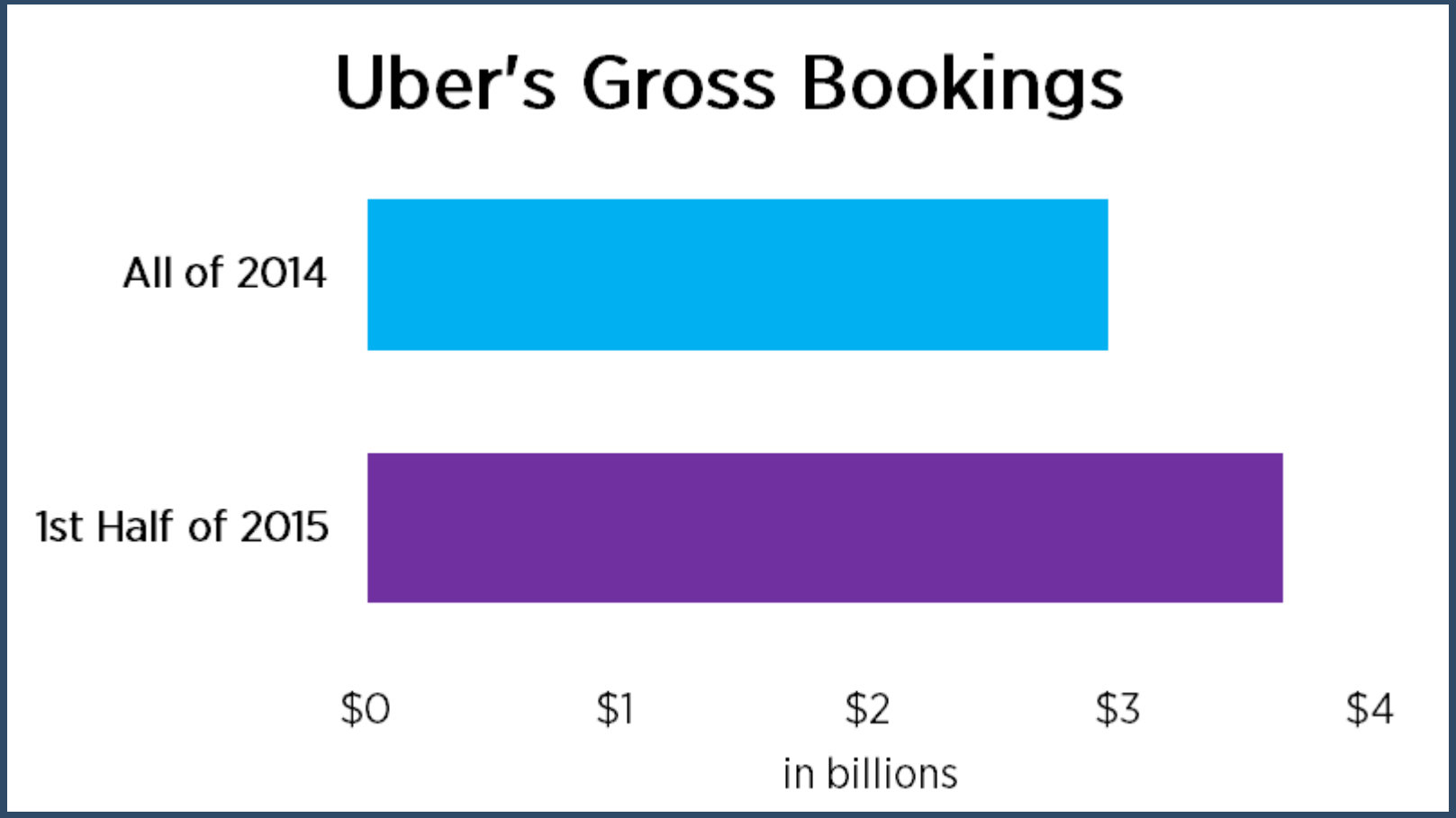
what else?.

What else has been happening the last 5 years?

choice. 2010-2015

choice. 2010-2015

choice. 2010-2015


Uber's Gross Bookings
All of 2014
1st Half of 2015
$0
$1
$2
$3
$4
in billions

travel ■ TECHNOLOGY TRENDS

Reduce Congestion & Greenhouse Emissions

Congestion costs Americans living in cities an additional 5.5 billion hours and an extra 2.9 billion gallons of fuel.

60%
of passengers use their personal vehicles less because of Lyft

46%
avoid owning a personal vehicle entirely because of Lyft

Expand Transportation Access

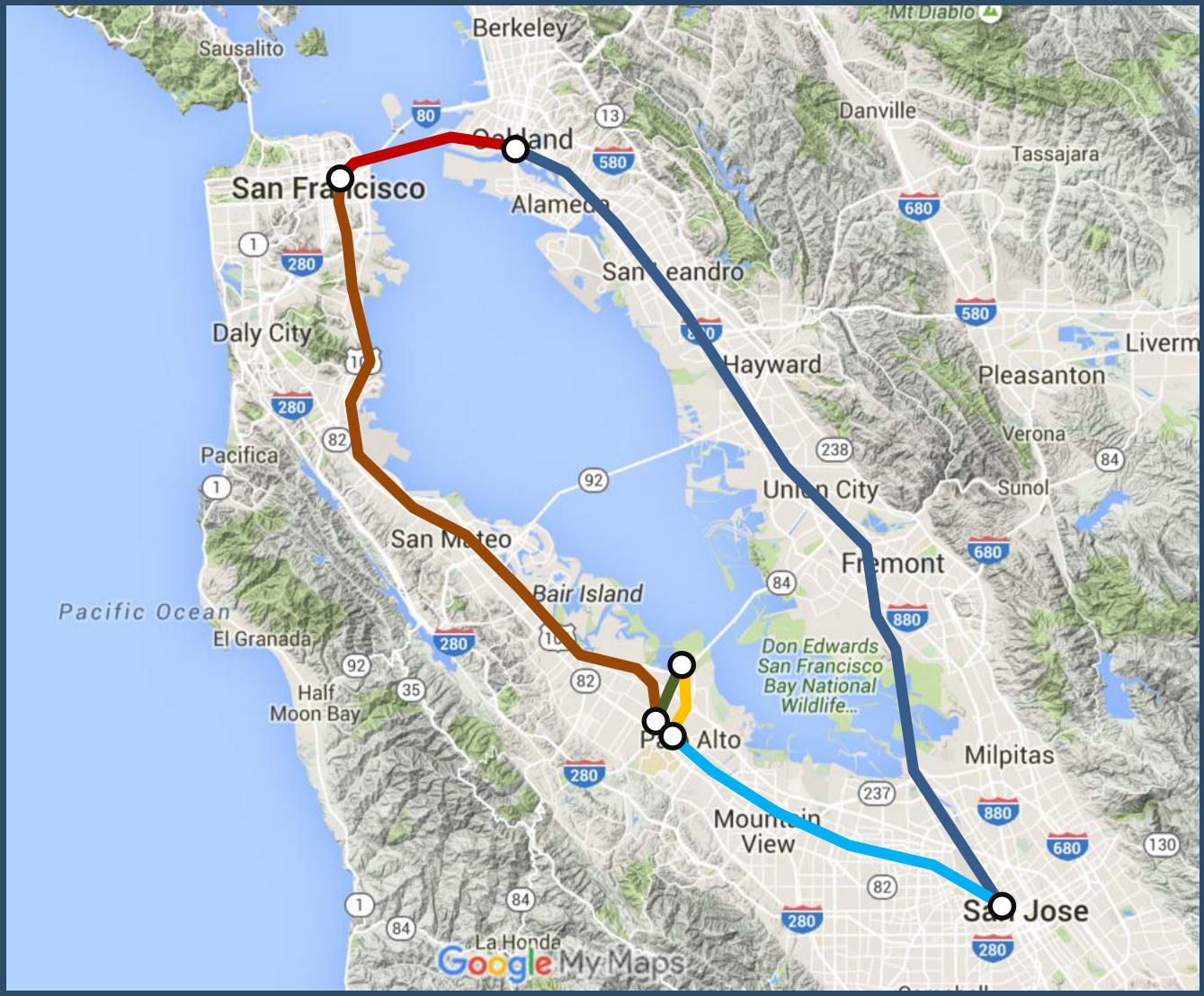
Fewer than 50% of Americans report living within ¼ mile of a transit stop.[2]

25%
use Lyft to connect to public transit

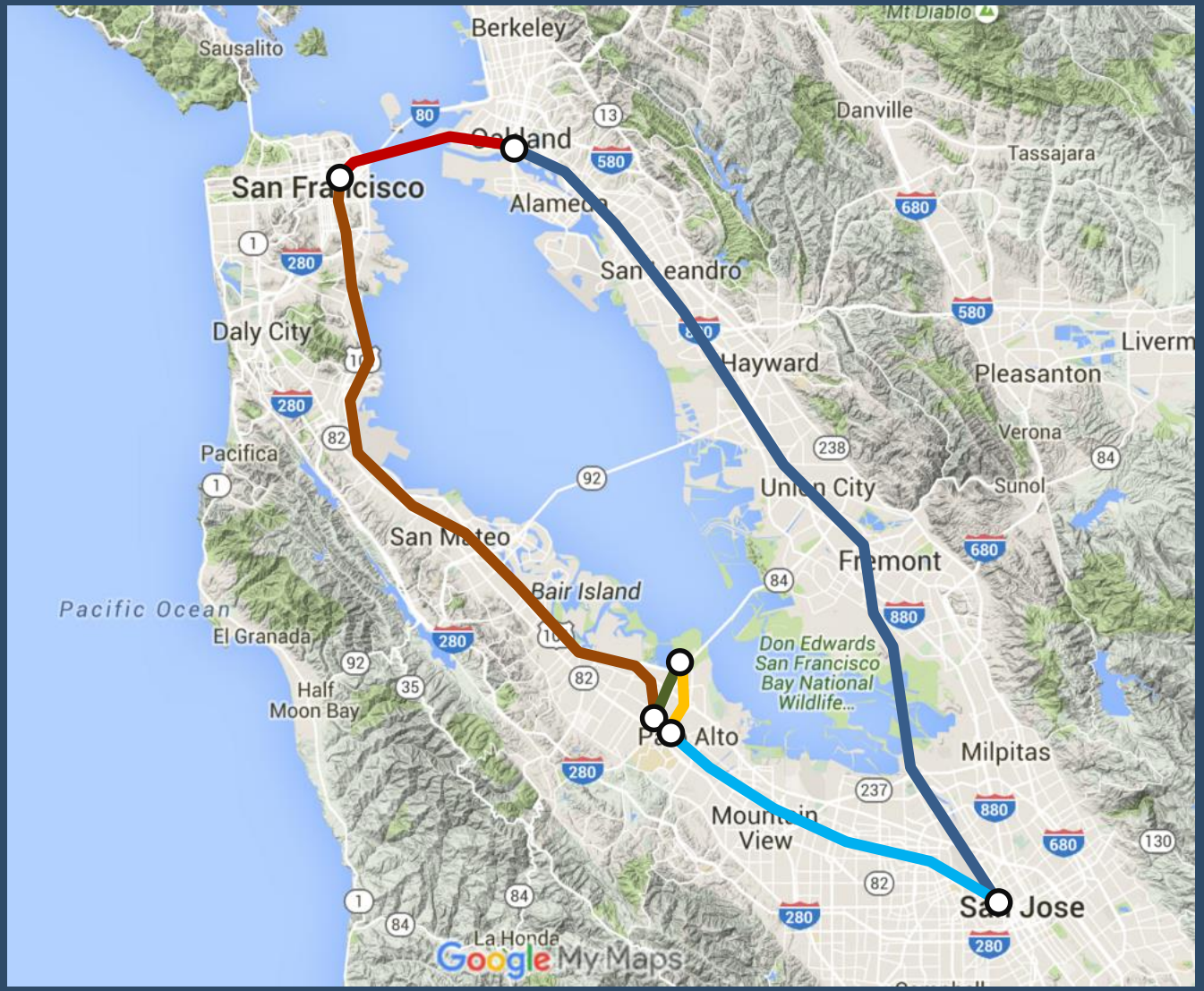
54%
say Lyft allows them to get to places that are otherwise inaccessible

travel

TECHNOLOGY TRENDS



travel ■ TECHNOLOGY TRENDS



VMT in 2015:
41 miles

VMT in 2010:
106 miles

trends.

FACTORS IMPACTING VMT

Trends marked with * actually work in the opposite direction of VMT change

trends. FACTORS IMPACTING VMT

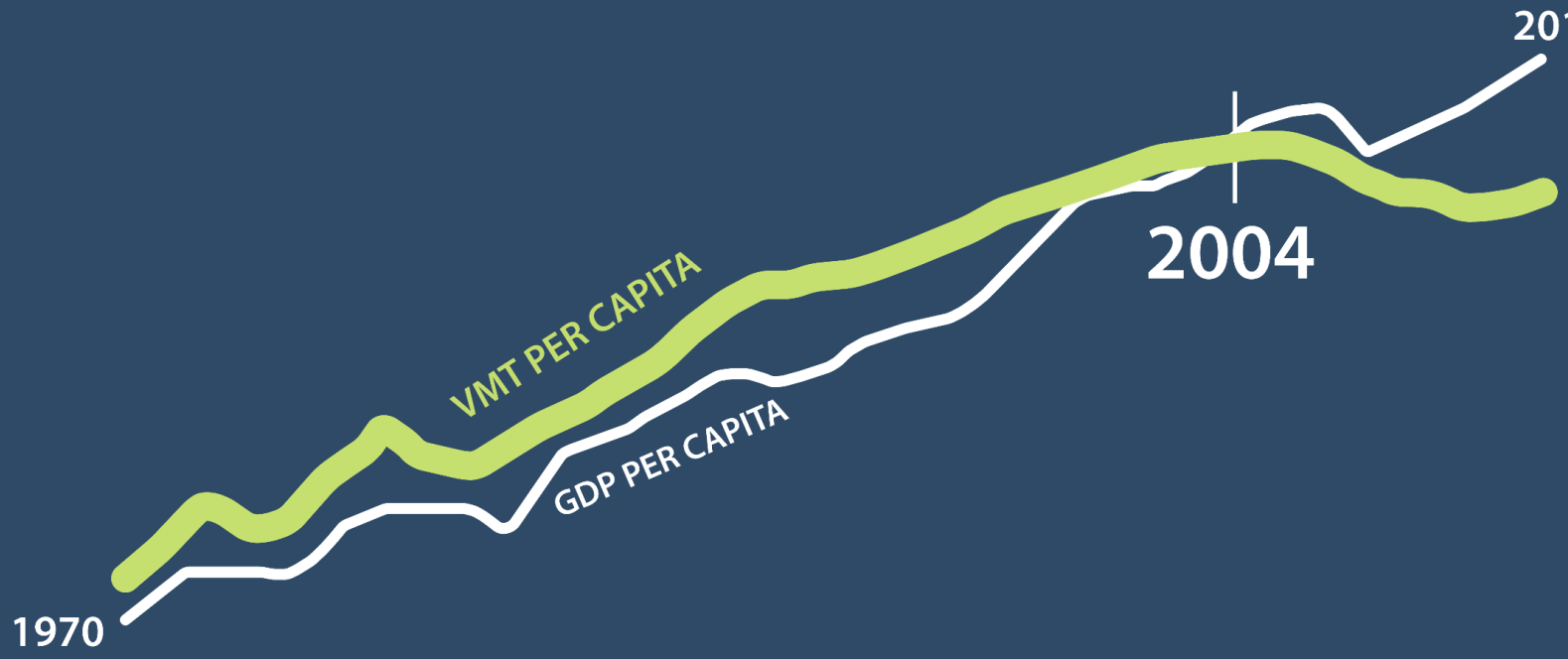
1970-2004 - increase

- Labor Force Participation
- Driving Age Population
- Vehicle Ownership
- Licensing Regulations
- Gasoline Prices
- Congestion & Time Use
- Non-Auto Mode Options
- GDP, Real Income Growth
- Suburban & Urban Migration
- Household Formation
- Goods & Services Delivery
- Tele-Commuting
- Social Networking
- Internet Shopping

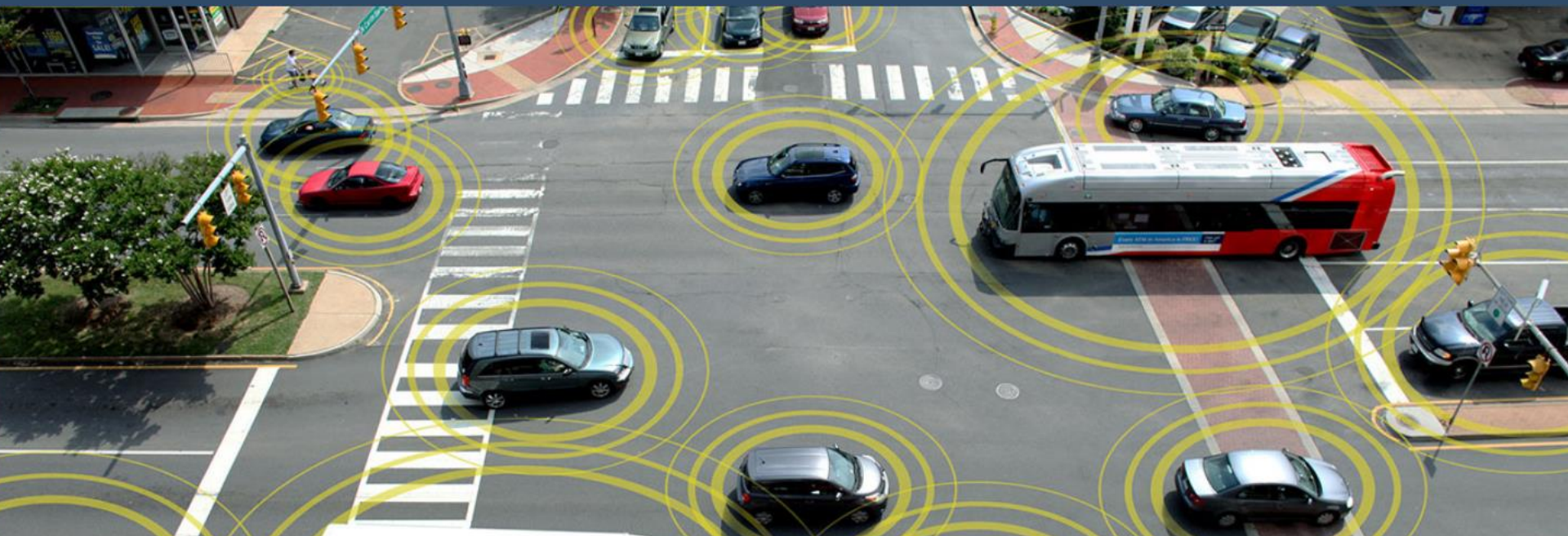
trends.

FACTORS IMPACTING VMT

2004 -2014 - decrease



part 3. TRAVEL TRENDS FUTURE



part 3. TRAVEL TRENDS FUTURE

"Prediction is difficult, especially when dealing with the future"

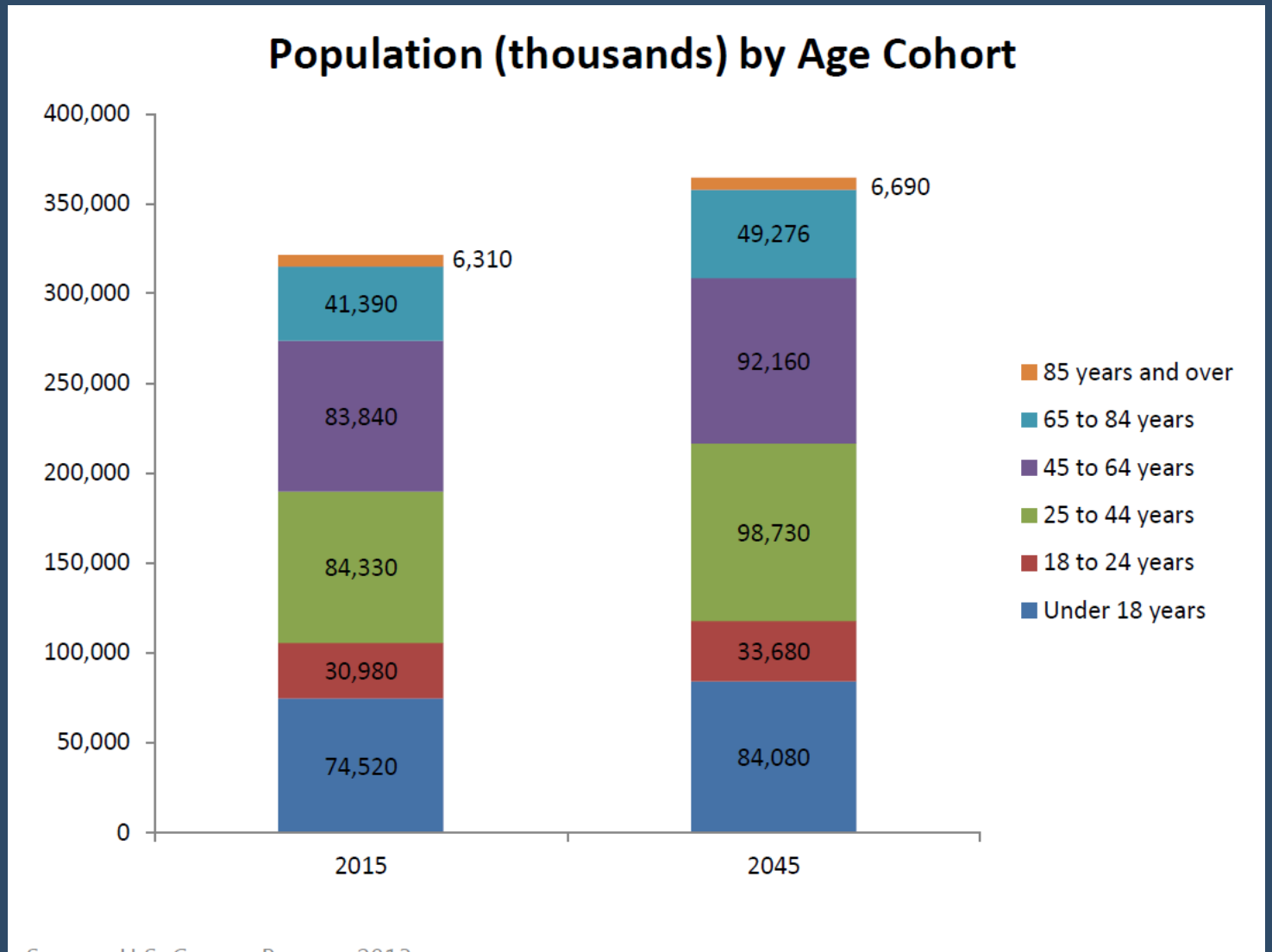
Danish Proverb

uncertainty TRAVEL TRENDS FUTURE

"Very smart people have very different opinions on the pace of implementation, market acceptance, and impacts of technology in transportation. But, folks are hungry for answers, and in the absence of information speculation is running rampant"

Steven Polzin, University of South Florida

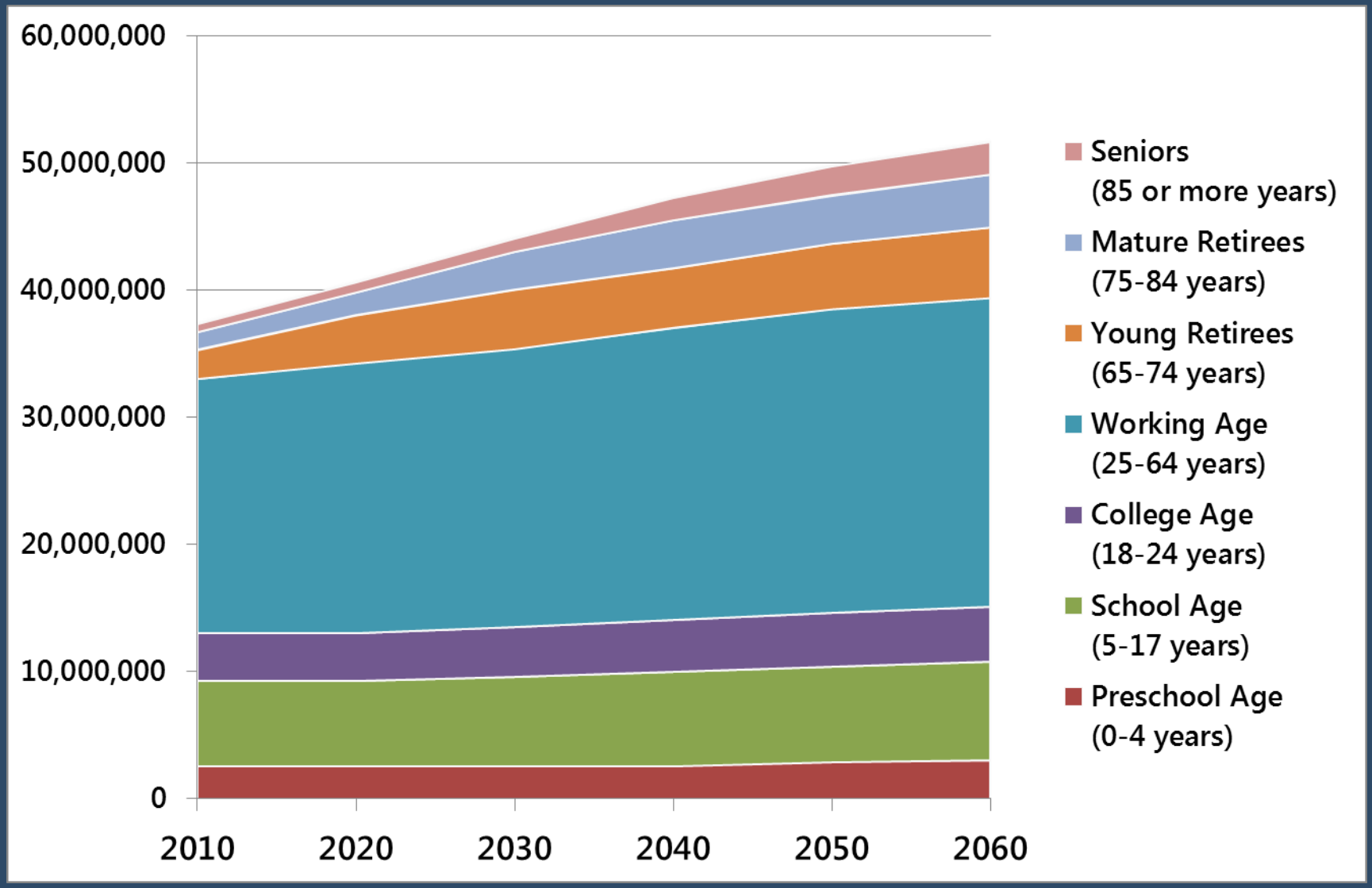
trends. US POPULATION GROWTH



Source: U.S. Census Bureau, 2013.

trends.

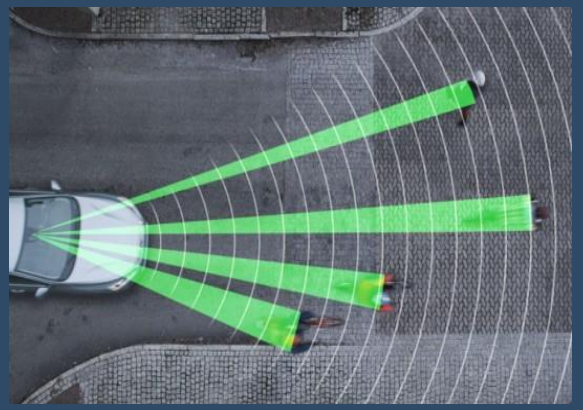
CALIFORNIA POPULATION GROWTH



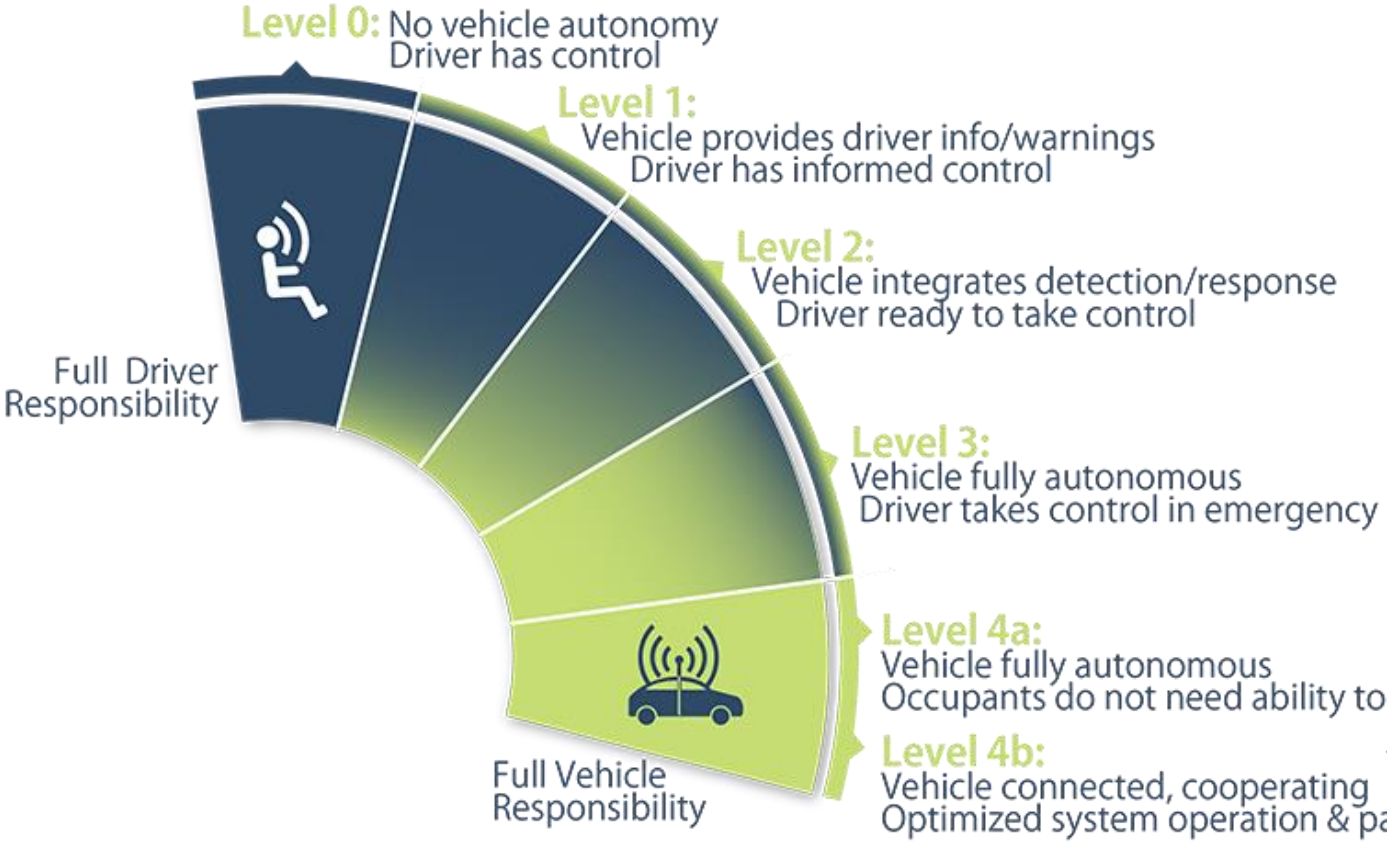
trends. FACTORS IMPACTING FUTURE VMT

Trends marked with * actually work in the opposite direction of VMT change

next generation vehicles.



vehicle evolution. FLEET ABSORPTION



2015

?

vehicle evolution. FACTORS


Renault Nissan Boss Says Autonomous Cars Could Be Ready By 2018


Autonomous Cars Like The Google May Be Viable In Less Than 10 Years

Neil Winton
Contributor
FOLLOW

I cover Europe's car manufacturers, their business, tech, products

+ Comment Now + Follow Comments

BRUSSELS, Belgium – President Barack Obama's motorcade, abetted by the limousine cavalcades of his G7 leader colleagues and non-stop rain, bought traffic to a standstill here this week, making those stranded in their cars or diving into the underground railroad system for relief wonder whether computer controlled cars might one day make this aggravation a thing of the past.

News of Google GOOGL +0.18% 's autonomous car, which can transport two passengers around at speeds of up to 25 mph with the computer controlling the steering wheel and brakes, has set off speculation about just when this technology will be available.

Discounts
Drive Safe& Save


Everyone Will Have Self-Driving Car By 2026, Analyst Says

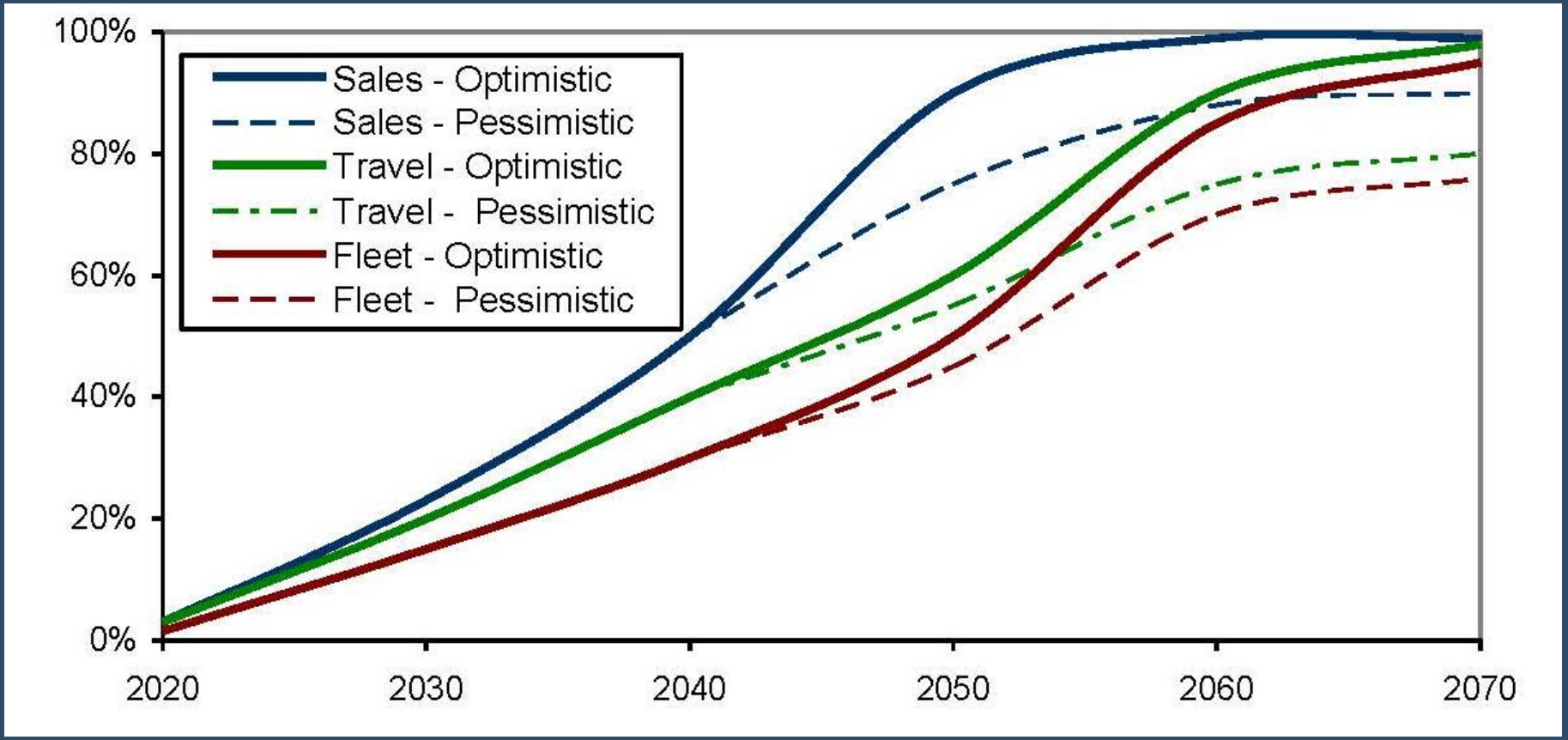
Adam Jonas isn't Nostradamus, but the

- Technology
- Licensing/Insurance
- Legal/Liability
- Privacy/Security
- Cost/Equity
- Popularity of cars as service

changes to come? IMPACTS ON VMT

Factor	Reasons for VMT increase	Reasons for VMT decrease
Driver Experience	• Reduced stress • Multi-tasking and improved passenger position	• Latent demand/congestion negates stress reduction
Safety	• Safety improvements reduce vehicle weight and costs • Incident-related congestion is reduced	• Risk compensation • Liability concerns
Vehicle Cost of Ownership	• Reduced vehicle size decreases vehicle cost • Insurance costs reduced	• Technology increases costs • Continued downward trend in ownership rates
Previous Non-Drivers	• Added population of new drivers (elderly, disabled, under 16)	• Out of reach for low-income and many current non-drivers

possible autonomous vehicle trajectory



Source: VTPI, 2013

scenarios

2015 TO 2040: WHERE DO WE GO FROM HERE?

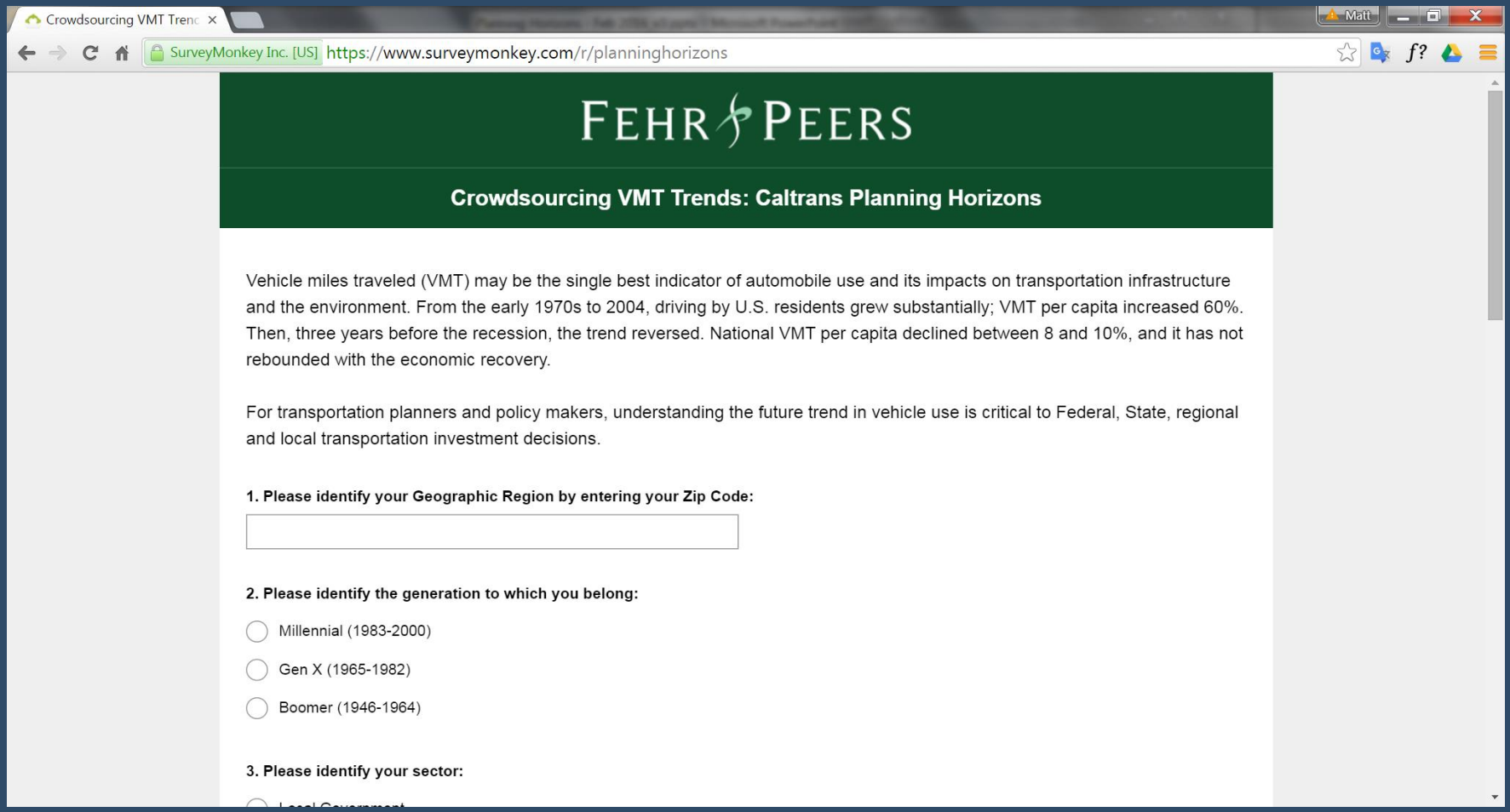
TRENDLAB

survey.

www.surveymonkey.com/r/planninghorizons

scenarios. 2015 TO 2040

www.surveymonkey.com/r/planninghorizons



scenarios. 2015 TO 2040

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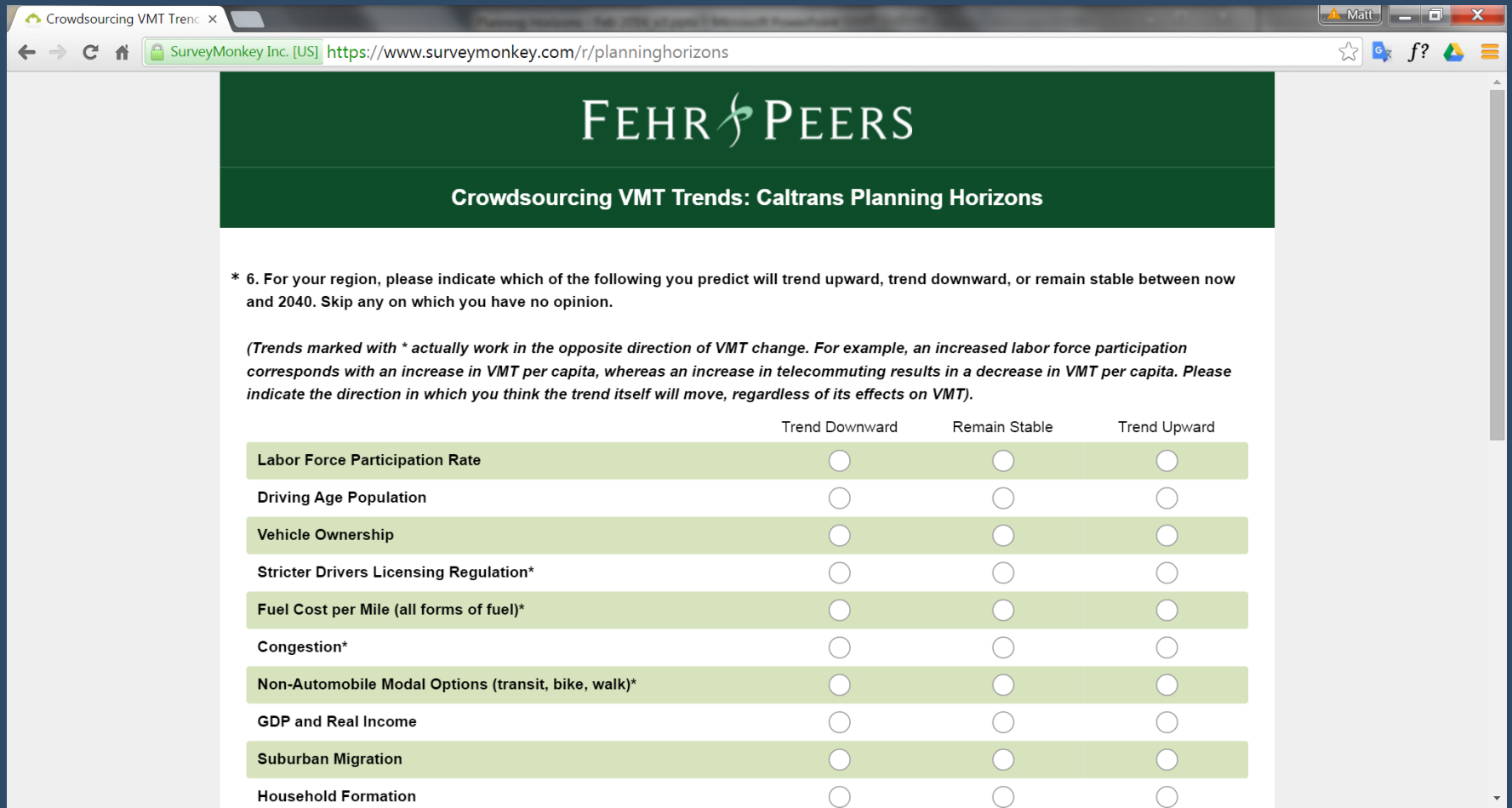

scenarios. 2015 TO 2040

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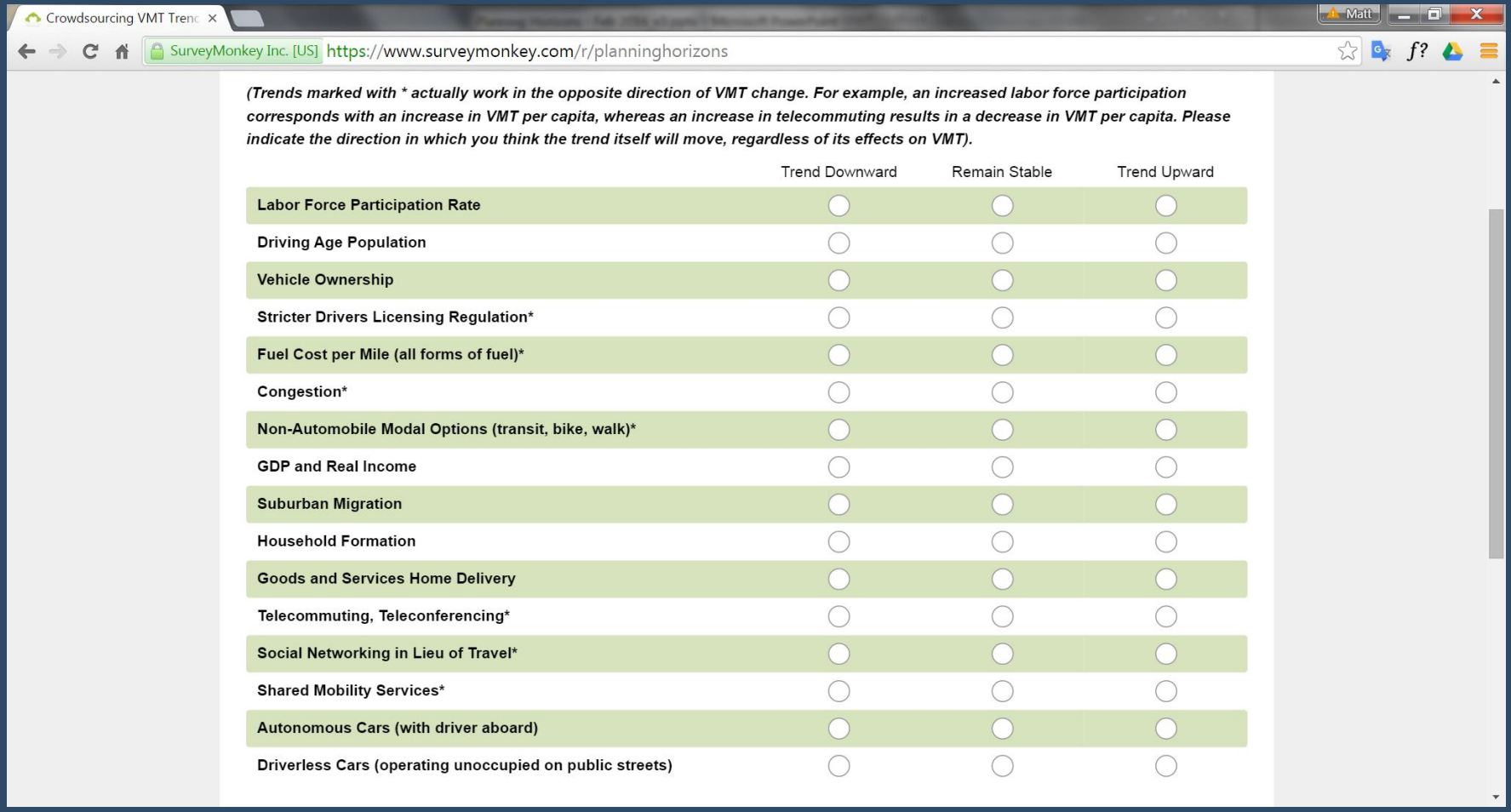

*(Trends marked with * actually work in the opposite direction of VMT change. For example, an increased labor force participation corresponds with an increase in VMT per capita, whereas an increase in telecommuting results in a decrease in VMT per capita. Please indicate the direction in which you think the trend itself will move, regardless of its effects on VMT).*

	Trend Downward	Remain Stable	Trend Upward
Labor Force Participation Rate	○	○	○
Driving Age Population	○	○	○
Vehicle Ownership	○	○	○
Stricter Drivers Licensing Regulation*	○	○	○
Fuel Cost per Mile (all forms of fuel)*	○	○	○
Congestion*	○	○	○
Non-Automobile Modal Options (transit, bike, walk)*	○	○	○
GDP and Real Income	○	○	○
Suburban Migration	○	○	○
Household Formation	○	○	○
Goods and Services Home Delivery	○	○	○
Telecommuting, Teleconferencing*	○	○	○
Social Networking in Lieu of Travel*	○	○	○
Shared Mobility Services*	○	○	○
Autonomous Cars (with driver aboard)	○	○	○
Driverless Cars (operating unoccupied on public streets)	○	○	○

scenarios. 2015 TO 2040

Labor Force Participation

Details | Assumptions

Jobs recovery brings return of commuting, other travel

Effect on VMT: large-magnitude and direct

Possible Trend-Up Scenario

Recessions have occurred every 5-10 years since we've been tracking the economy, and recoveries have occurred at the same frequency. GDP is up, employment is up, and we're seeing strong signs that the Great Recession is ending.

Millennials enter workforce in larger numbers.

Boomers continue working beyond traditional retirement age.

Possible Trend-Down Scenario

A "jobless recovery" leads to stagnating employment.

Job skills of recent graduates will erode before jobs become available to them, and student loan repayment will diminish discretionary spending.

The trend of increasing female employment peaks.

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scenarios. 2015 TO 2040

Driving Age Population

Details | Assumptions

Post millennials come of age, Boomers retire but remain active

Effect on VMT: medium-magnitude and direct

Possible Trend-Up Scenario

Boomers are more active, retiring later, living longer. As a result, they will continue to drive and remain mobile via their cars.

Demographic effects in total return to 2004 levels, but will not increase due to travel time budgets.

Possible Trend-Down Scenario

Boomer retirements represent the biggest outflow from the labor force in history.

Considering all cohorts (Boomers, Gen Xers, Millennials, Post-Millennials), driving among members of a particular age group will continue to decline. Post-Millennials will drive even less than Millennials do today, meaning VMT will continue to decline from generation to generation.

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scenarios. 2015 TO 2040

Vehicle Ownership

Details | Assumptions

Recent urban trend to living car free and sharing cars, bikes and rides reverses

Effect on VMT: low-magnitude and direct

Possible Trend-Up Scenario

In their youth, Boomers also flocked to cities as Millennials now do, but once they began forming families, they moved to suburbs in search of good schools and backyards and as a result, VMT per capita has tripled.

Possible Trend-Down Scenario

Millennials are setting a new social and environmental agenda focused on urban living and are foregoing car ownership.

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scenarios. 2015 TO 2040

Licensing Regulations

Details | Assumptions

Additional states adopt graduated licensing laws, further reducing teen driving

Effect on VMT: low-magnitude | Indirect

Possible Trend-Up Scenario

Millennials will reach licensure rates of previous generations once they reach their late 20s and early 30s.

Possible Trend-Down Scenario

Stricter teen licensure laws will spread to more states, curtailing licensure rates among Millennials.

www.surveymonkey.com/r/planninghorizons

scenarios. 2015 TO 2040

Gasoline Prices

Details | Assumptions

Gas prices rise at or above rate of inflation, reducing discretionary driving

Effect on VMT: large-magnitude and inverse

Possible Trend-Up Scenario

Projected to remain at high levels that helped produce the VMT slowdown in the early 2000's.

Possible Trend-Down Scenario

Vehicle fuel efficiency and North America energy independence will result in stable to lower cost per mile.

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scenarios. 2015 TO 2040

Congestion and Time Use

Details | Assumptions

With rising congestion, limits on willingness to spend time traveling, reduces travel distances

Effect on VMT: medium-magnitude and inverse

Possible Trend-Up Scenario

To the extent that travel time can be used for productive purposes (autonomous vehicles, premium comfortable transit) travel time budgets will increase.

Possible Trend-Down Scenario

"Marchetti's Constant" suggests that all people have a maximum amount of travel they will conduct during the course of each day. Recent analyses of relatively constant travel times indicate we have reached the maximum travel budgets. Polzen's historic look at the American travel behavior shows that while travel times (and therefore travel budgets) in the US have increased, additional increases at high rates are unlikely.

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scenarios. 2015 TO 2040

Non-Auto Mode

Details | Assumptions

Emergent alternative travel options (demand-response transit, car and bike sharing, complete streets) shift choices from driving
Effect on VMT: medium-magnitude and inverse

Possible Trend-Up Scenario

Transit ridership grew twice as fast as population from 1995 to 2011 thanks to centralization of development and investment in transit. Developer and community-planned focus of new housing and jobs in transit priority areas (especially around the west) maintains this trajectory in urban preference patterns.

Possible Trend-Down Scenario

Planned transit capacity expansions cannot keep pace with planned concentration on TOD.

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scenarios. 2015 TO 2040

GDP, Real Income Growth

Details | Assumptions

Rising household income increases driving

Effect on VMT: medium-magnitude and direct

Possible Trend-Up Scenario

VMT per capita follows the recent rebound in GDP per capita

Improving economy increases median incomes

Possible Trend-Down Scenario

VMT per capita does not rise with rising GDP per capita

The remaining economic recovery does not occur in terms of inflation adjusted increases in median household incomes

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scenarios. 2015 TO 2040

Suburban Migration

Details | Assumptions

Recent migration of millennials and boomers to urban centers reverses

Effect on VMT: medium-magnitude and direct

Possible Trend-Up Scenario

Although they may be committed to urban living now, Millennials may be more like their parents than they care to admit, moving to the suburbs in order to raise their families.

Boomers will stick with what they know, primarily houses in the suburbs, as they age in place. Their travel will not change substantially, because they'll retire later, remain active and live longer than prior generations.

Possible Trend-Down Scenario

Millennials will continue to prefer housing that supports a diverse set of transportation choices

Housing developers, private investment, and government reforms to encourage infill housing will allow housing supply to keep pace with changing preferences

Boomers mimic previous generations, toward lower VMT, using their wealth to invest in one of the safest investments that can be made – new housing in urban, walkable locations.

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scenarios. 2015 TO 2040

Household Formation

Details | Assumptions

Economic conditions, social preferences return to traditional household forms and travel patterns

Effect on VMT: medium-magnitude and direct

Possible Trend-Up Scenario

Considering all cohorts (Boomers, Gen Xers, Millennials, Post-Millennials), driving among members of a particular age group will continue to decline. Post-Millennials will drive even less than Millennials do today, meaning VMT will continue to decline from generation to generation.

Possible Trend-Down Scenario

Millennials will eventually be able to find jobs, buy homes, raise families.

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scenarios. 2015 TO 2040

Goods & Services Delivery

Details | Assumptions

Same-day home delivery becomes widespread, increasing delivery VMT Effect

Effect on VMT: medium-magnitude and direct

Possible Trend-Up Scenario

Internet ordering, 3D printing, and same-day delivery will allow consumer VMT associated with goods and services to decline, although small order, just-in-time shipping will increase delivery VMT.

Possible Trend-Down Scenario

Small order, just-in-time shipping will increase delivery VMT for goods and services, but internet ordering, 3D printing, and same day delivery will allow consumer VMT associated with goods and services to decline.

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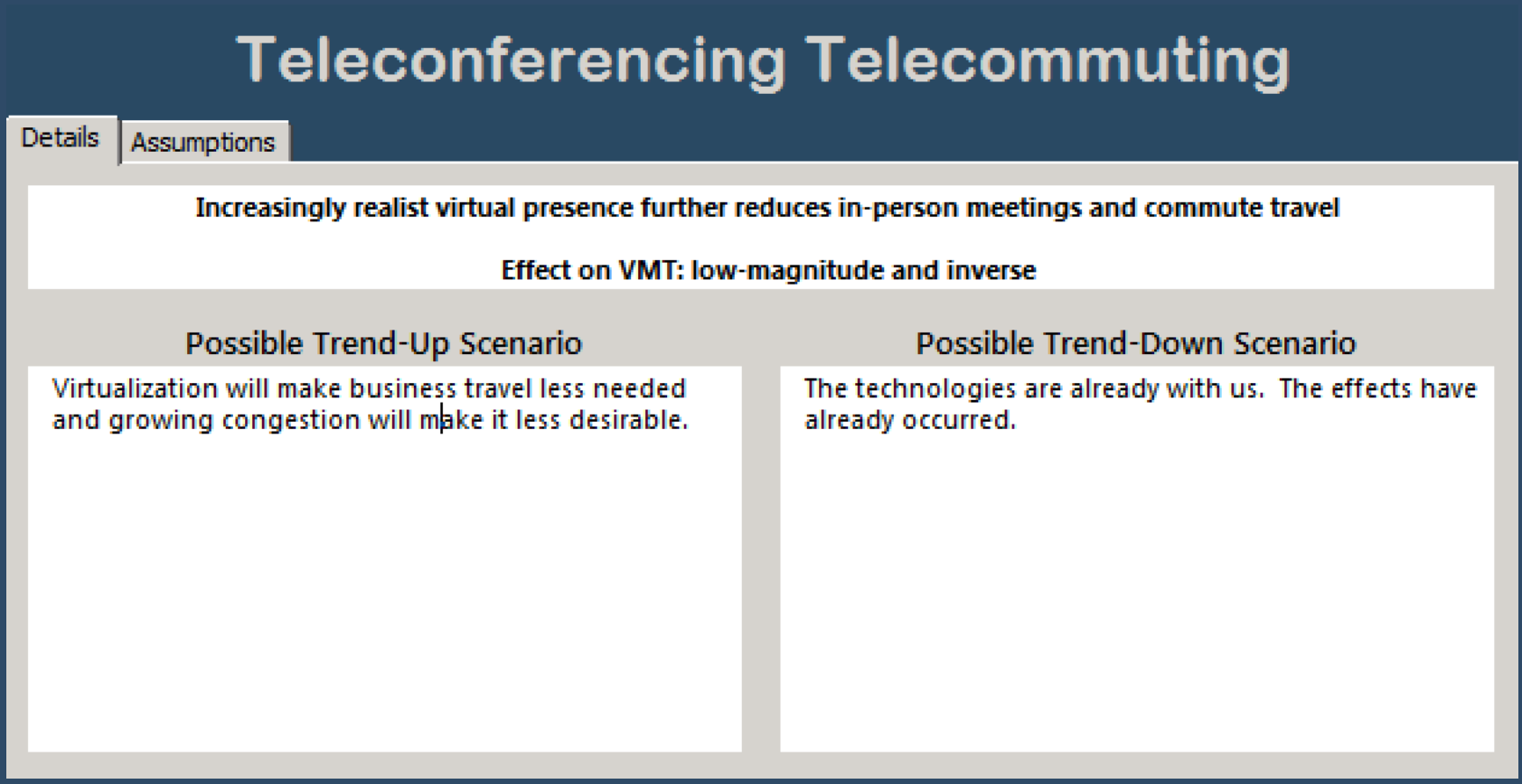
scenarios. 2015 TO 2040



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scenarios. 2015 TO 2040

Social Networking

Details | Assumptions

Virtual forums increasingly substitute for face-to face social encounters and entertainment

Effect on VMT: low-magnitude and inverse

Possible Trend-Up Scenario

Connected applications and sharing economy will play a bigger and bigger role in human interaction, further reducing solo travel and in-person encounters that depend on driving

Possible Trend-Down Scenario

The effect has run its full coarse and future change will be minimal to non-existent. Social networking will continue to alter vehicle ownership and per-capita driving, but only to the degree have already has

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scenarios. 2015 TO 2040

Shared Mobility Services

Details | Assumptions

Increase VMT by expanding mobility options and increasing deadhead mileage to maintain high level of service

VMT Effect | Medium | Direct

Possible Trend-Up Scenario

Users of shared mobility services replace some transit and walk/bike trips and the increase in services provided increases the deadhead VMT produced by the individual shared mobility service vehicles.

Possible Trend-Down Scenario

Increase in shared mobility services provides enhanced mobility that allows a larger proportion of population to reduce their car ownership and thereby decrease their overall VMT as mobility is provided on a cost-per-mile and cost-per-minute basis.

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scenarios. 2015 TO 2040

Autonomous Cars (driver aboard)

Details | Assumptions

Self-driving cars reduce stress, give freedom to multi-task, increasing acceptance of travel time

Effect on VMT: low-magnitude and direct (2040), medium-magnitude and direct (2060)

Possible Trend-Up Scenario

Added safety and operating characteristics reduce travel stress and offer freedom to multi-task, increasing acceptance of even longer travel time times and distances.

Possible Trend-Down Scenario

Government regulation, liability concerns and purchase prices, and multi-year time frames for fleet turnover will delay widespread presence for 30 years.

Conservative programing of traffic performance will reduce travel time benefits and dampen consumer enthusiasm.

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scenarios. 2015 TO 2040

Driverless Vehicles

Details | Assumptions

Unoccupied vehicles in continuous circulation, driverlessly serving on-demand travel needs

Effect on VMT: medium-magnitude and direct (2040), large-magnitude and direct (2060)

Possible Trend-Up Scenario

Reduced parking requirements will create a significant benefit to real estate, development costs and urban environments, accelerating adoption.

Government approvals do not impose significant long-term roadblocks.

Use becomes common in dense urban settings and services for those outside normal range of driving age and physical ability.

Possible Trend-Down Scenario

Government regulation, liability concerns and purchase prices, and multi-year time frames for fleet turnover will delay widespread presence for 40+ years.

Restrictions against cars floating empty in urban environments will reduce unnecessary VMT but also reduce responsiveness and use.

Conservative programing of traffic performance will reduce travel time benefits and dampen consumer enthusiasm.

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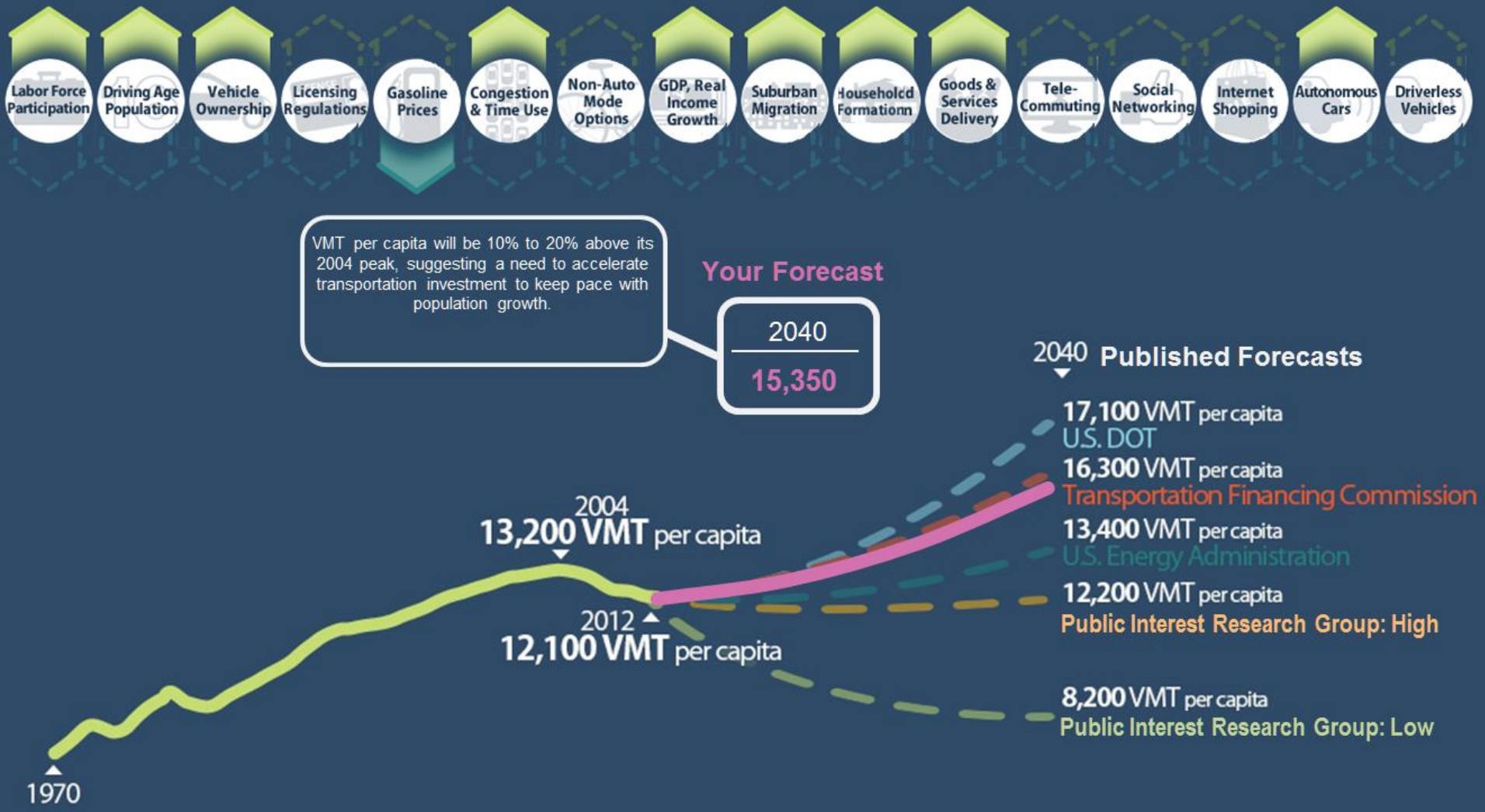
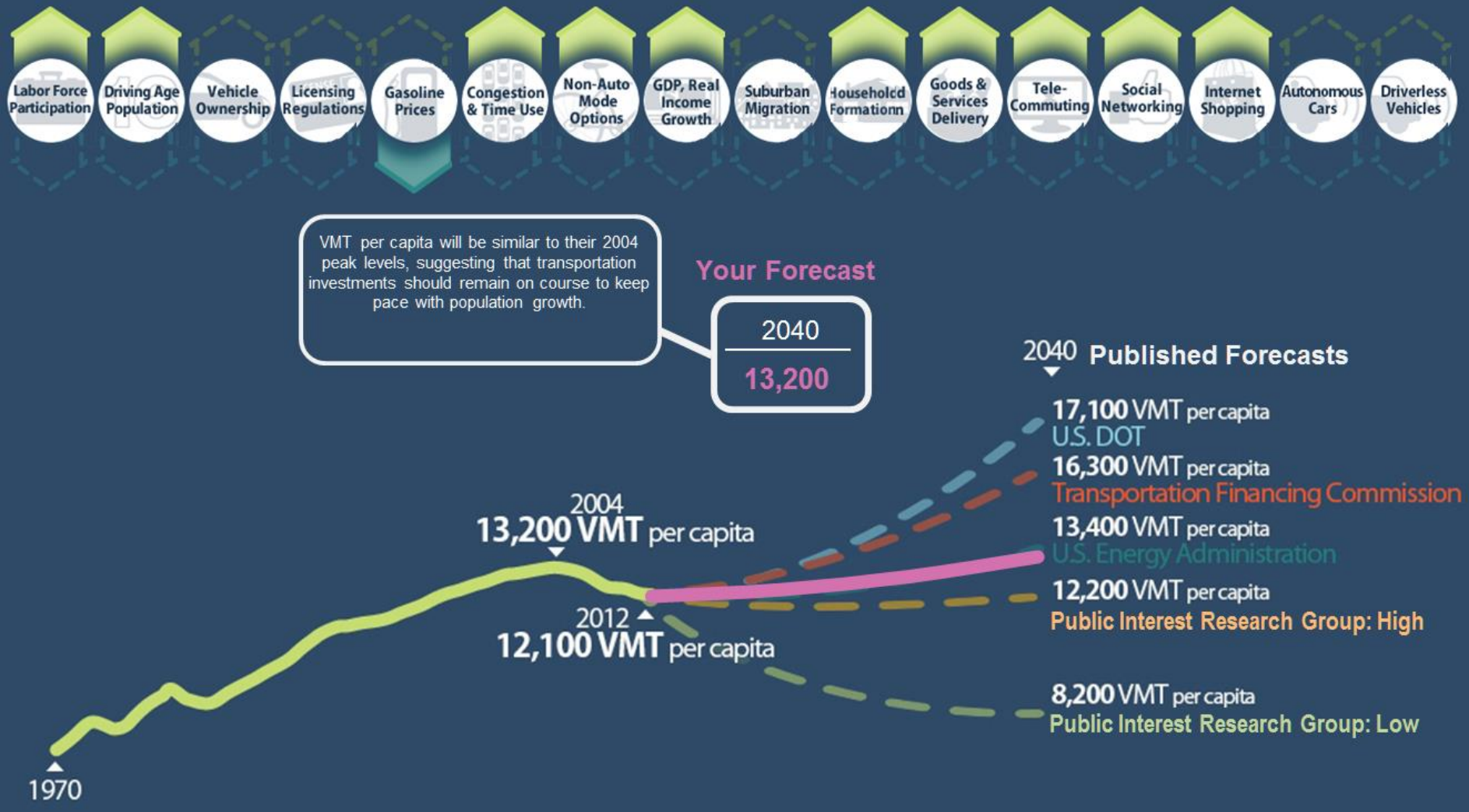
scenario:
Economic recovery, stable technology adoption



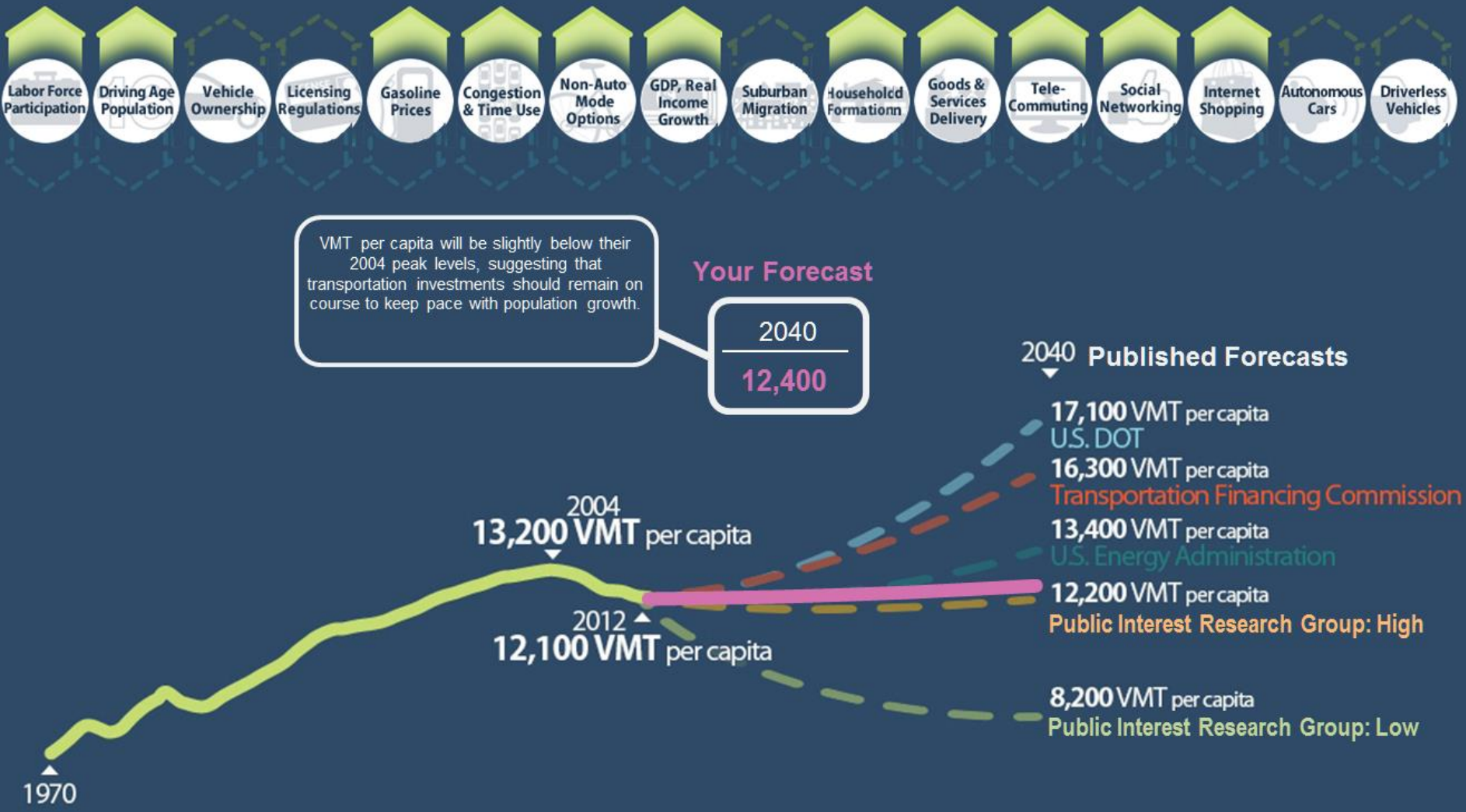
scenario:

Economic recovery with millennial lifestyles



scenario:

Millennial lifestyles, economy and gas prices rebound



scenario:
Caltrans Planning Horizons

TRENDLAB+

implications.

- Understand and plan for uncertainty
- Expand model sensitivities
- Test assumptions, experiment, refine
  - The cost of doing nothing is greater than the cost of failure

“You can’t solve exponential problems with linear solutions”

Banny Banerjee,

Stanford ChangeLabs Director

THANK YOU!

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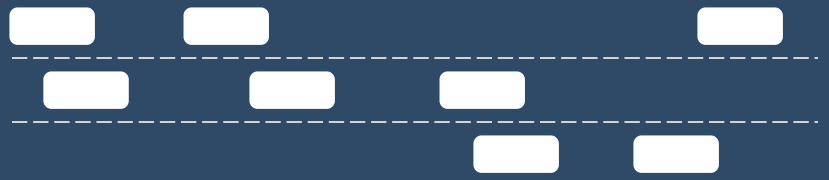
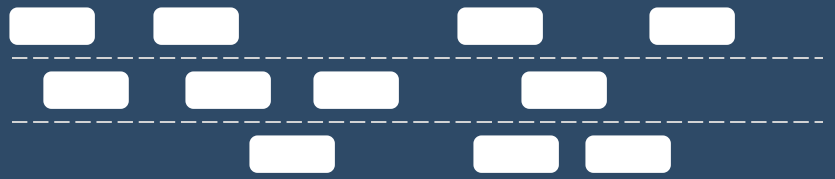
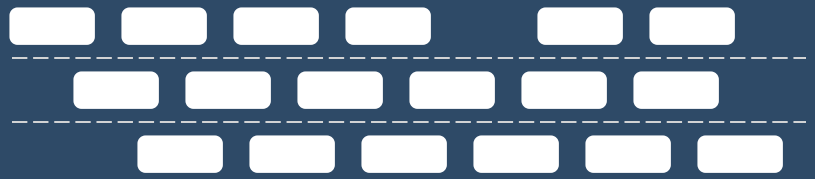
Possible Effect on capacity?

Autonomous Fleet Mix		Capacity Increase
50%		0-30%
75%		0-40%
95%		50-100%

Source: http://www.fehrandpeers.com/fpthink/nextgenerationvehicles/