Drivers of Change for Metropolitan Transportation: An Overview

Transportation Research Board
Scenarios in Transportation Planning
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Terry Moore, ECONorthwest

Underlying Assumptions

Public Action à

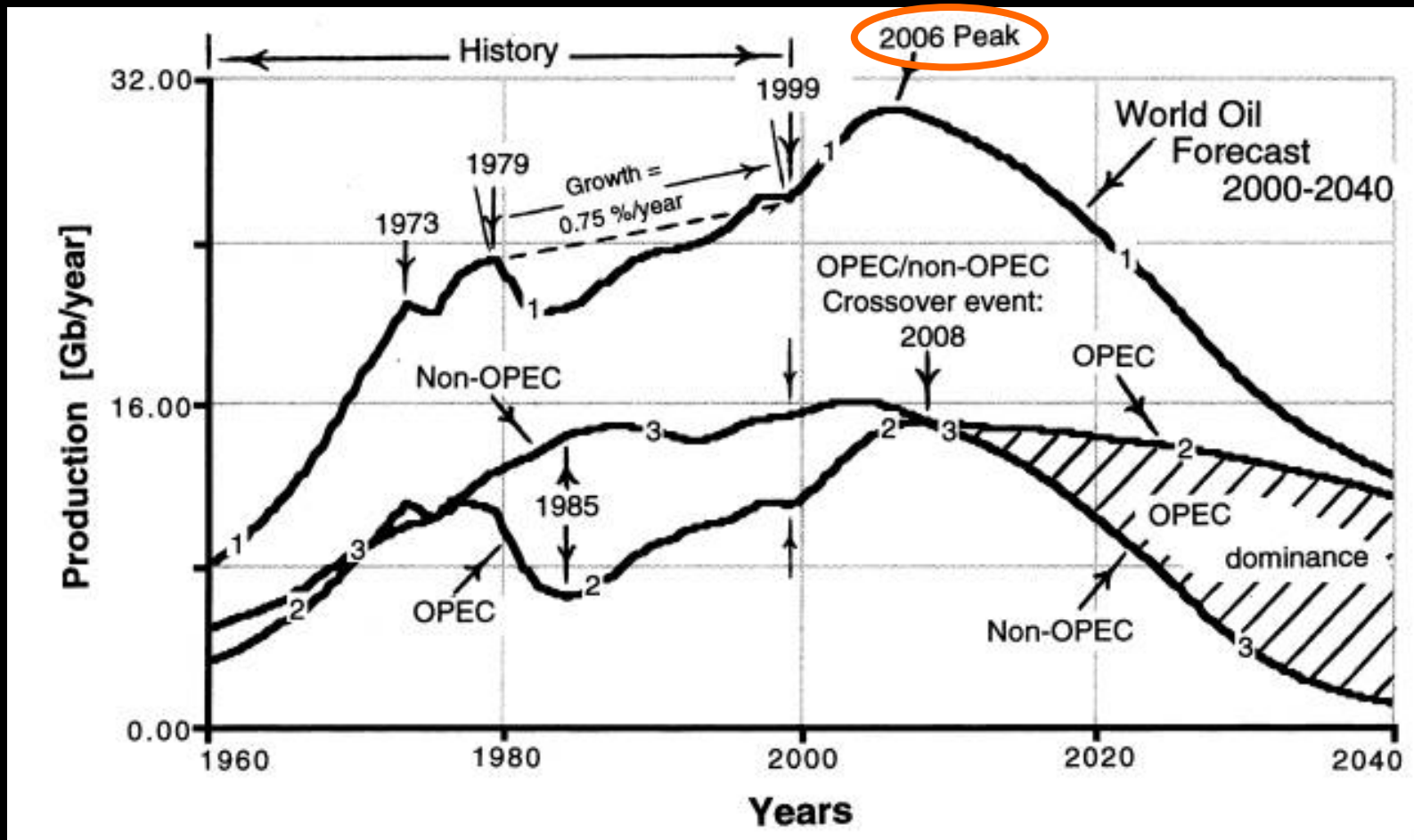Future Betterment à

• Forecasting

Data

Devils in the Data

Quantity + Complexity
+ Uncertainty + Change
= Forecasting Problems

Some examples…

Economics: Supply + Prices

Environment

Heat Waves

Scripps News
SCRIPPS INSTITUTION OF OCEANOGRAPHY

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Tuesday, February 12, 2008

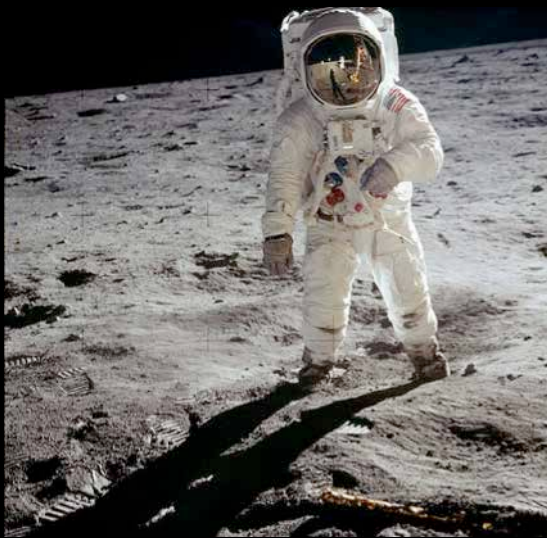Lake Mead Could Be Dry by 2021
Analysis of current and scheduled use a

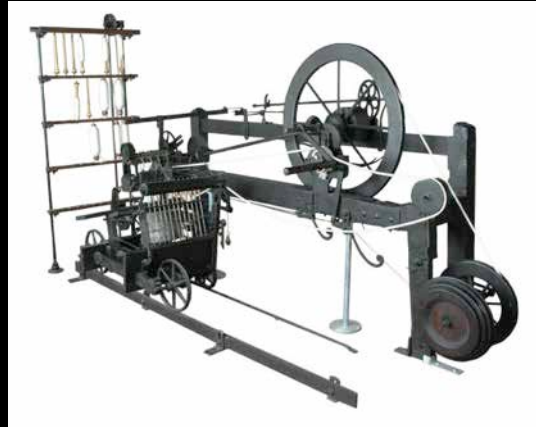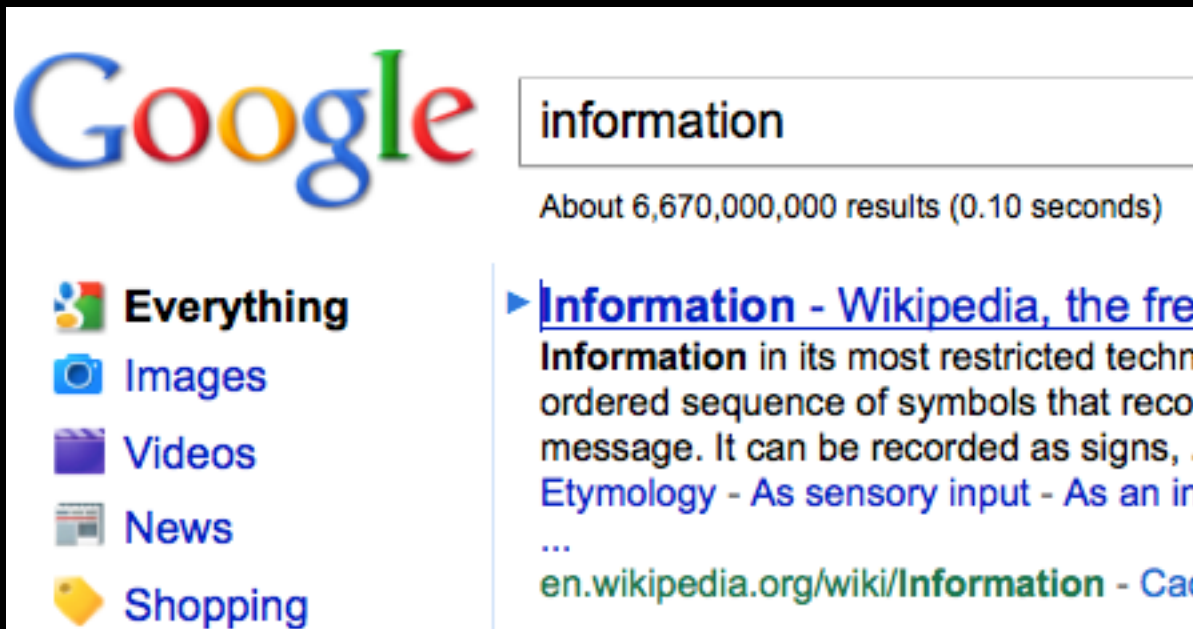# Possible, but Plausible…?

And in the other corner…

Technology

Social Change

▪ Exponential growth of information and <u>access</u> to information > globalization and democratization > social change > better *policy*?

Five broad categories of Drivers

Trends (momentum), innovations (choices), disruptions likely to influence future demand for travel and the facilities and programs to accommodate it.

Demographics

Environment

Technology

Economics

Policy

Freepik
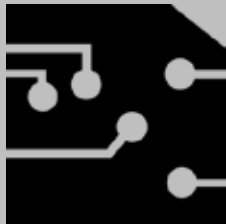
Drivers Affect Things We Care About
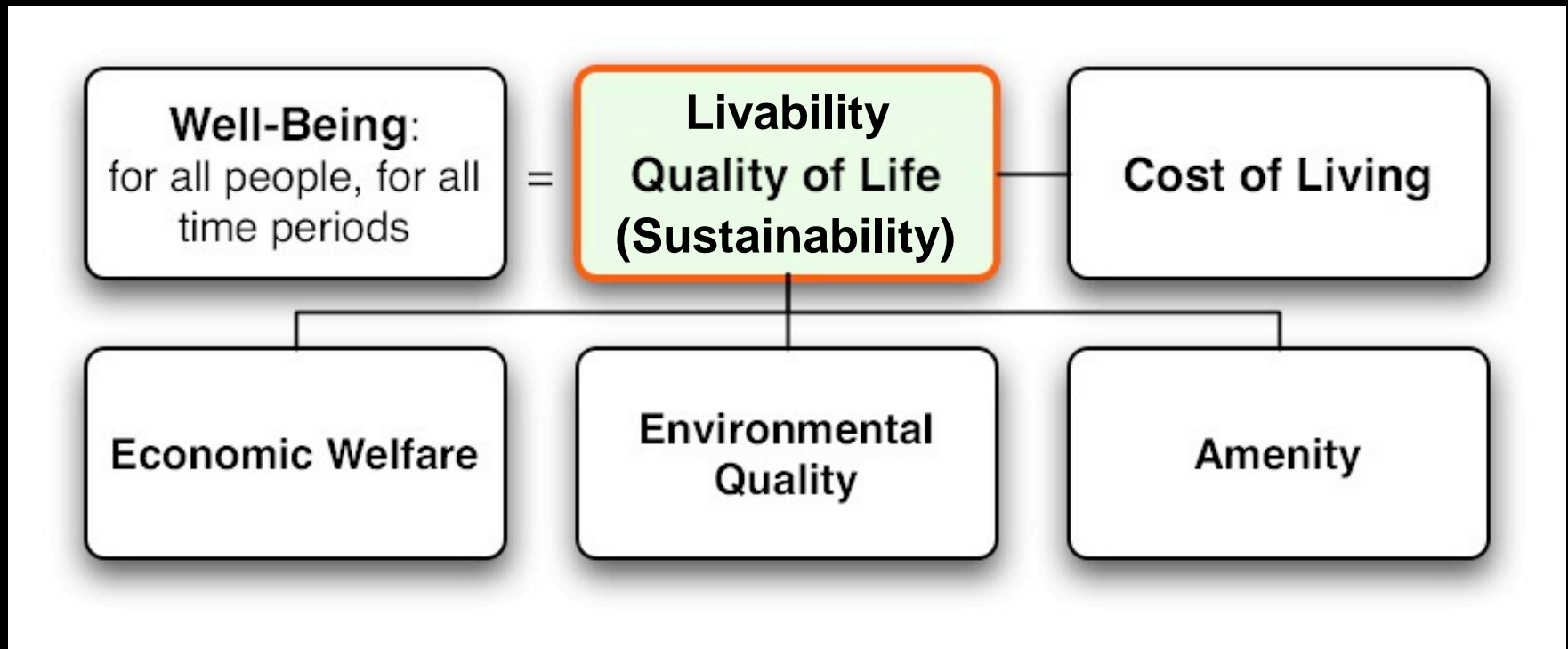
Those are Categories of Impacts

- **Effects on Everything**
  - Economy
  - Environment
  - Land Use
  - Infrastructure
  - Social
  - Fiscal
  - Public Process
  - (Legality: usually implied)

- **Transportation System Performance**
  - Safety
  - Speed (accessibility and mobility)
  - Reliability (Resilience)
  - Choice
  - Convenience
  - Cost / Effectiveness / Fiscal Constraint
  - Distribution of impacts (equity)
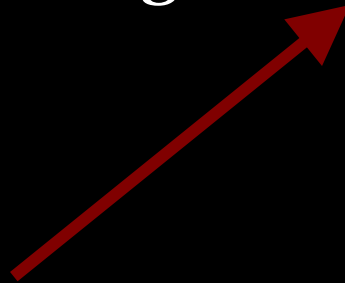
For Transportation Projects…

- **Transportation System Performance**
  - Safety
  - Speed (accessibility and mobility)
  - Reliability (Resilience)
  - Choice
  - Convenience
  - Cost / Effectiveness / Fiscal Constraint
  - Distribution of impacts (equity)

- Secondary Effects
  - Economy
  - Environment
  - Land Use
  - Infrastructure
  - Social
  - Fiscal
  - Public Process
  - (Legality: usually implied)

The Elevator Speech

- 5 broad *Categories of Drivers*; 100s of specific, plausible drivers

- Combine some *Specific Drivers* to create *Scenarios*

- Evaluate scenarios (their *Impacts*) against *criteria* (*measurements*) in well-established categories of what we care about

- Use models for *estimates* of future impacts

Washington County Transportation Futures Study

- 50-year look as context for 10-to-20-year Transportation Investment Package

- Drivers, Scenarios, Investment Packages

Methods for Evaluating Drivers

- **Literature Review**
- **Survey of National Experts**
  - ~ 40 invited; ~ 20 responses
  - Two rounds; Modified Delphi
  - Round 1: What drivers are most relevant; are most likely to occur; would have biggest impacts on transportation?
  - Round 2: Given results of Round 1, more focused questions
- **Survey of Local Interested Parties**

Demographic Factors Population levels | Population composition | Family and household size | Housing and land-use preferences | Travel behavior and preferences | Consumer behavior and preferences | Social behavior | Education levels

Economic Factors Employment levels | Occupational composition of economy | Economic sectors | Global trade | Domestic trade | Price of commodities | Labor force participation

Environment and Energy Price of energy | Types of energy | Sea level | Temperature levels | Weather patterns | Water levels and watersheds | Critical habitats

Policy Fuel taxes | Federal, state, local transportation funding | GHG regulation | Road and congestion pricing | Incentives for alternative energy or transportation technology | Transit subsidies | Insurance and safety regulations | Local and regional land use policies | Emerging world powers and geo-politics

Technology Vehicle technology | Alternative fuels | Traffic management | Consumer and communication technology | Infrastructure technologies

Literature Review

Demographics

Aging population

Increase in online shopping

Telecommuting

Policy

Congestion pricing

PPPs in transportation

Climate change regulation

Environment

Natural resource constraints

Rising sea levels

Intensifying weather

Technology

Autonomous/connected vehicles

Ubiquitous ITS

Automation of knowledge work

Economics

Emerging global middle class

Increase in technology and service industries

Increasing East Coast port traffic

Survey 2

- Considering the results of Survey 1:
  - What drivers are most important and what are their potential effects?
  - Can and should potential drivers be incorporated into travel demand models?
  - How likely are some potential scenarios for the future of transportation?

5 Driver Categories: multiple responses from Survey 1

Individual: Top 5

Collective Frequency in Top 15

Mean estimates and Std Deviation of Likelihood and Importance

Weighted Score

Table 1: List of drivers by category, frequency, average probability and impact

	Frequency in Top 15	Average Probability (1-5)	Average Probability Std. Dev.	Average Impacts (1-3)	Average Impacts Std. Dev.	Score*	Frequency in Top 5
Demographic and Societal Drivers							
Aging population	14	4.5	0.8	2.4	0.7	149	8
Telecommuting	13	3.4	0.9	1.9	0.8	85	6
Online shopping	8	3.8	1.2	2.1	0.6	64	2
Urbanization	5	4.2	0.4	2.6	0.5	55	3
Other demographic changes	4	4.3	1.0	2.5	1.0	43	1
Alternatives to vehicle ownership	4	3.8	0.5	2.3	1.0	34	2
Population growth	3	4.7	0.6	2.7	0.6	37	2
Growing extremism/terrorism	2	3.0	0.0	2.0	0.0	12	-
Economic Drivers							
Emerging global middle class	12	3.3	1.4	1.8	0.9	70	2
Increase in service- and technology-based industries	11	4.1	0.7	1.8	0.8	82	2
East coast port traffic	7	2.7	1.0	1.3	0.5	24	-
Increasing income inequality	4	4.0	0.8	1.8	1.0	28	1
Rising energy costs	3	4.3	1.2	2.3	1.2	30	2
Economic growth and personal income	3	5.0	0.0	2.0	1.0	30	1
Environment and Energy Drivers							
Intensifying weather and environmental conditions	10	3.5	1.2	1.9	0.7	66	4
Natural resource constraints	10	3.6	1.3	1.9	0.9	68	2
Sea levels	8	3.4	1.3	1.8	0.5	47	2
Water scarcity	4	3.3	1.0	1.8	0.5	23	-
Government and Policy Drivers							
Privatization and public-private partnerships in transportation financing	12	3.4	1.0	1.8	0.8	72	4
Road pricing, including congestion pricing and vmt taxes	11	3.3	1.1	2.8	0.4	101	10
Climate change regulations at the federal, state, and local level	11	3.5	0.9	1.8	0.9	71	3
Decline of federal funding	3	4.0	0.0	2.7	0.6	32	-
Technology Drivers							
Adoption of autonomous/connected vehicles	14	3.4	1.2	2.4	0.8	111	-
Advanced ubiquitous ITS	13	3.9	1.0	2.1	0.8	106	3
Automation of knowledge work	9	3.1	1.1	1.8	0.7	50	1
Ubiquitous broadband	2	4.0	0.0	1.5	0.7	12	-
Alternative fuel vehicles	2	4.0	0.0	2.0	0.0	16	1

For top rated, how would they impact (+ or −) key variables?
Pop Growth, Dev Density, # Commuters, Emp in Urban Core, Income Inequality, mode choice

Table 2: Top-rated drivers and their impacts

Impact on Key Variables

Driver

Relative Significance

| Driver | Frequency in Top 3 | Please indicate whether you think the driver will change these variables *significantly* enough to change transportation needs. (Values: Number that responded with "will decrease" / Number that responded with "will increase") | | | | | | Relative significance of driver |
		Population growth rate	Development density	Number of commuters	Employment in urban cores	Income inequality	Share taking non-auto trips	
Aging population	9	3 / 0	2 / 5	6 / 0	3 / 0	1 / 2	4 / 3	29
Congestion road pricing and VMT taxes	9	0 / 0	2 / 7	4 / 1	2 / 4	1 / 2	1 / 7	31
Urbanization and growth in metropolitan areas	6	1 / 3	0 / 5	0 / 5	0 / 5	0 / 3	0 / 5	27
Adoption of autonomous/connected vehicles	5	0 / 1	2 / 2	0 / 4	1 / 1	0 / 2	3 / 2	18
Climate change regulations at the federal, state, and local level	4	1 / 2	1 / 3	1 / 1	0 / 2	0 / 1	0 / 4	16
Privatization and public-private partnerships in transportation financing	3	0 / 0	0 / 2	1 / 1	0 / 2	0 / 1	2 / 1	10
Increase in online shopping	3	0 / 0	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0	3
Telecommuting	2	0 / 0	1 / 0	2 / 0	1 / 0	0 / 0	0 / 0	4
Natural resource constraints	2	0 / 1	0 / 2	2 / 0	0 / 2	0 / 1	0 / 2	10
Advanced ubiquitous intelligent transportation services (ITS)	2	0 / 0	0 / 1	0 / 1	0 / 1	0 / 1	0 / 0	4

Transportation Futures Study

Top Drivers from Experts

- Aging population
- Transportation pricing
- Growth in metropolitan areas
- Adoption of autonomous/connected vehicles
- Climate change regulations
- Online shopping

Rated by combined score for *likelihood* & *impact*

Aging Population

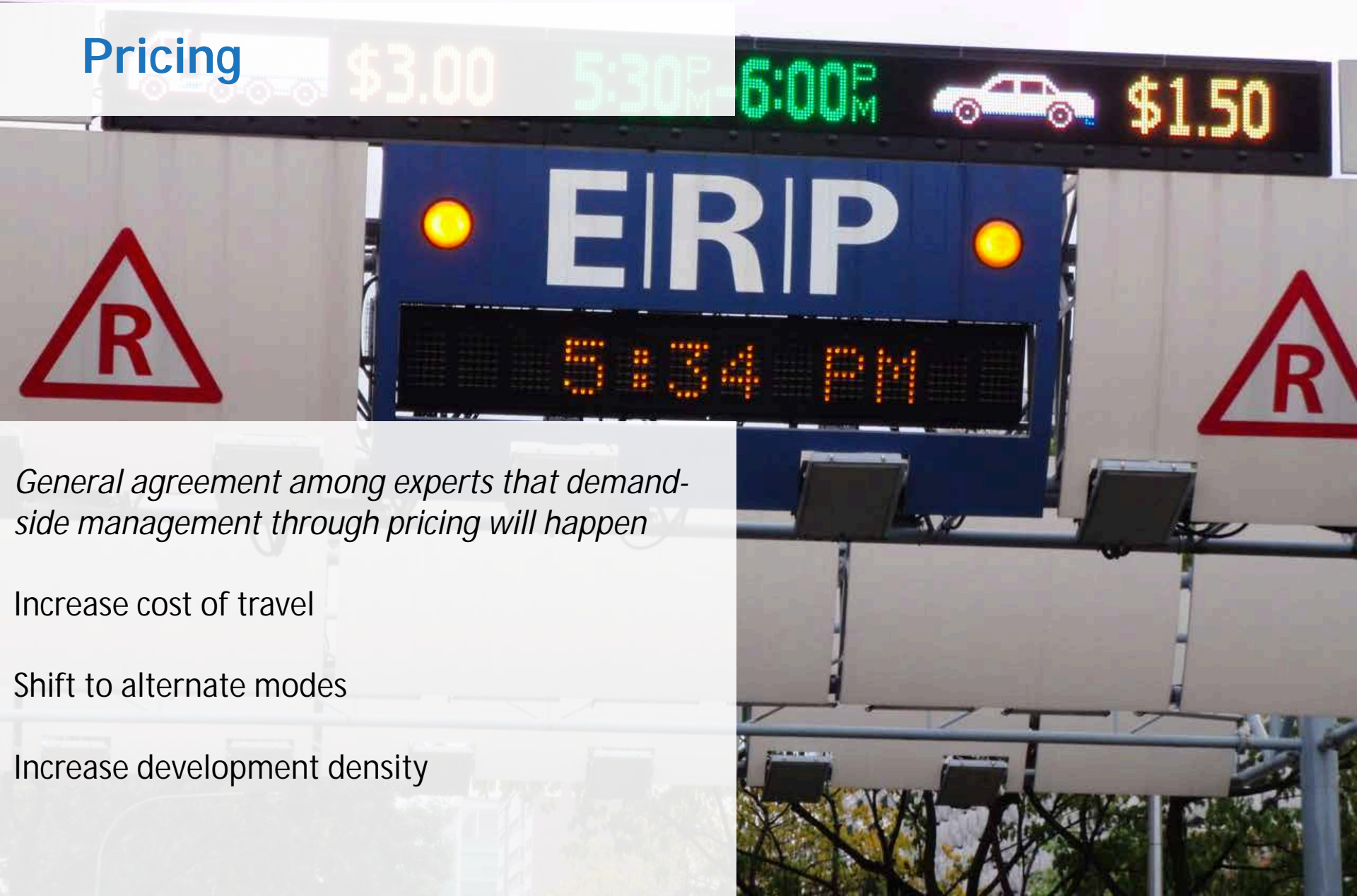*It's about more than the Boomers. Retirees in 40 years are 25 today.*

More "Retirees" but less retiring

Healthier

Wealthier

Unclear impacts on housing and transportation choices

Pricing

General agreement among experts that demand-side management through pricing will happen

Increase cost of travel

Shift to alternate modes

Increase development density

Growth in Metro Areas

Metro areas will continue to attract talent and jobs, and preferences will tend toward denser development

Could slow natural growth rate

Increase in density, number of urban commuters, jobs in urban core, non-auto trips, and possibly income inequality.

Adoption of autonomous/connected vehicles

Connected vehicles will phase into practice, with full autonomy less certain

Unclear impacts on development density

Increase in number of commuters

Climate change regulations at the federal, state, and local level

Climate change regulations will intensify and impact land use and transportation

General incentives for denser development and employment

Increase in non-auto trips

Likely increase in cost-of-living in metro areas, but will vary across metro areas

Privatization and public-private partnerships in transportation financing

Transportation funding constraints will encourage more creative and collaborative finance schemes with private sector

Unclear impacts on development density

Increase in number of commuters

Increase in Online Shopping

Online shopping will become more popular and widespread

Little impact on development density (but likely impacts on location of land uses and non-commute trips)

Regional Stakeholder Survey

- General agreement with experts
- Drivers relevant to local stakeholders
  - Funding limitations
  - Autonomous vehicles
  - Telecommuting
  - West Coast Shipping
  - 3D printing

Some Observations

- Try writing the questions
- No one complained about the structure
- High-level theory a lot easier than specifics
- Non-transportation drivers and policies may be more important to scenarios than transportation ones
- Paradox: (1) important to think long run and (2) impacts on planning investment hard to measure and may be small

Advice to Regions re Scenarios

- Thoughtful discussion and evaluation of drivers improves planning

- Packaging drivers into scenarios helps a public discussion of possible futures

- Don't get stuck. No end to potential tech work
  - Read what others have done on drivers
  - Check your models: what do they cover or not?
  - Write scenarios that make sense locally, and *list* the drivers that support those scenarios