Trucking's Future Now

MODERATOR: GREG COHEN

CEO

American Highway Users Alliance

FREIGHT INFRASTRUCTURE

COMMERCIAL VEHICLE OUTLOOK

Text Questions for the Speakers to: 862-781-0001.


COMMERCIAL VEHICLE
OUTLOOK
HDMA
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Trucking's Future Now

DAVID LEVINSON
Chair of Transportation
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Director Commercial Vehicle Safety
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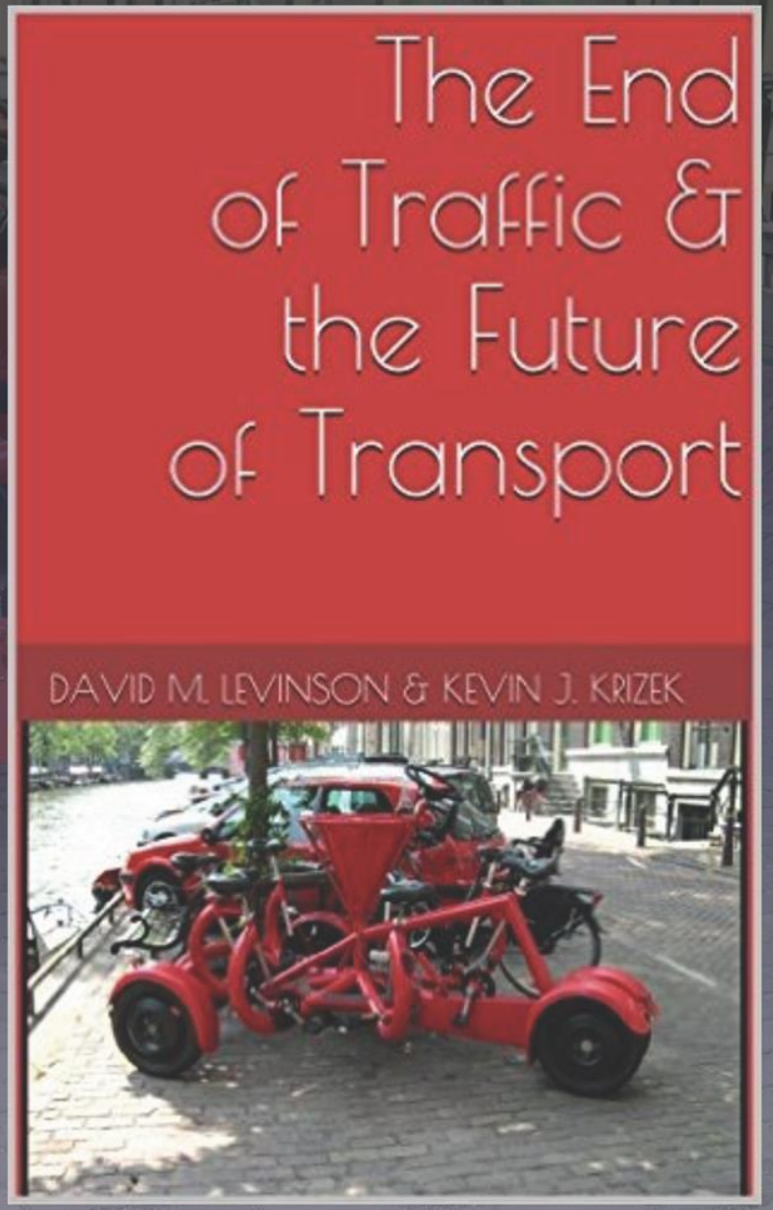
The Future of Freight

David Levinson
University of Minnesota

Materials adapted from

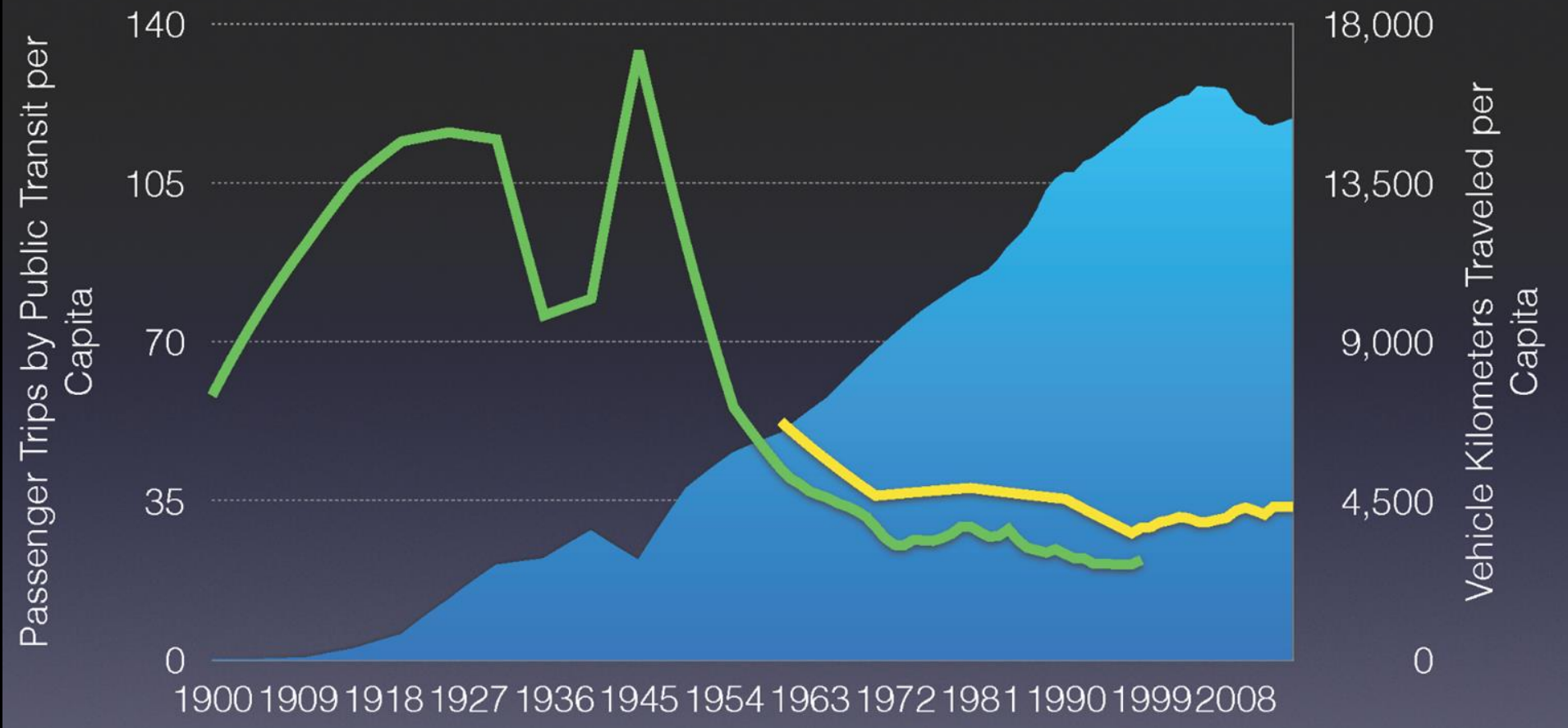


The End of Traffic and the Future of Transport by David Levinson and Kevin Krizek

Climbing Mount Auto

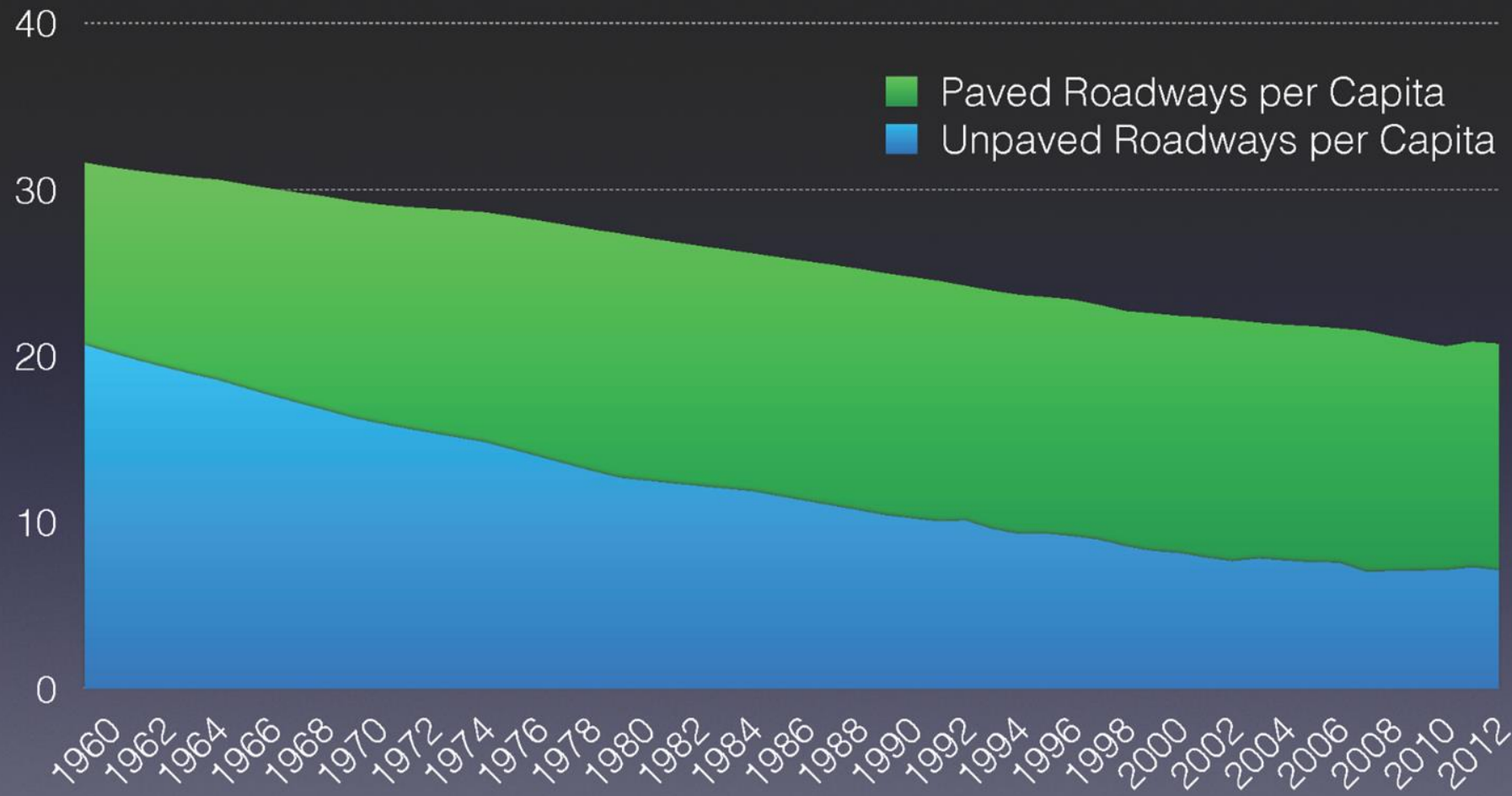
David Levinson
University of Minnesota

Figure 1.1: Climbing Mount Auto



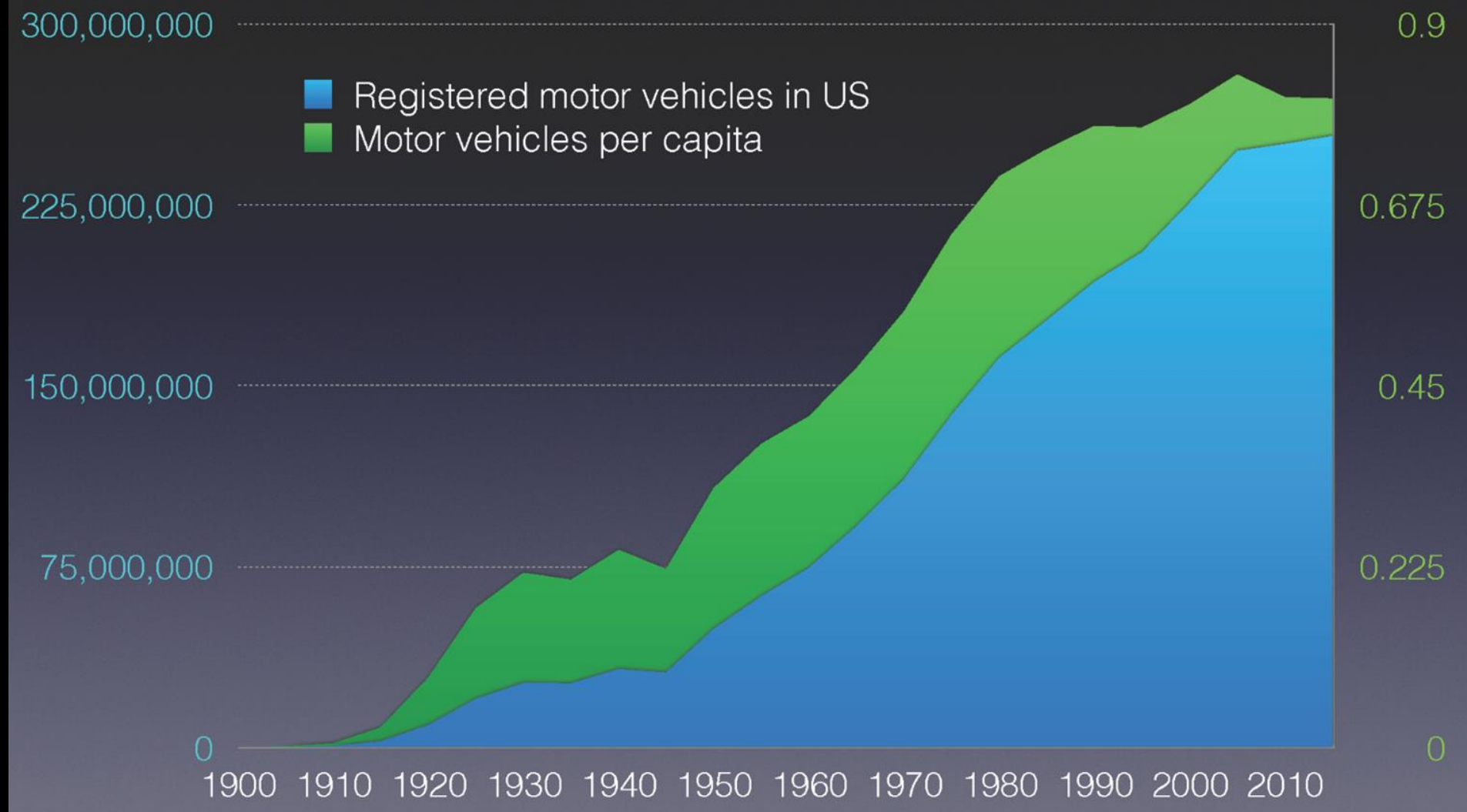
Note: The graph shows both linked and unlinked transit trips, as the way transit trips are counted has changed, and there is no continuous series of both over the entire period.
Source US Census Statistical Abstract http://www.census.gov/prod/2/gen/96statab/app4.pdf and US Federal Highway Administration: Highway Statistics http://www.fhwa.dot.gov/policyinformation/statistics/2012/vmt422c.cfm

Figure 1.2 Roadways per Capita in US (m)



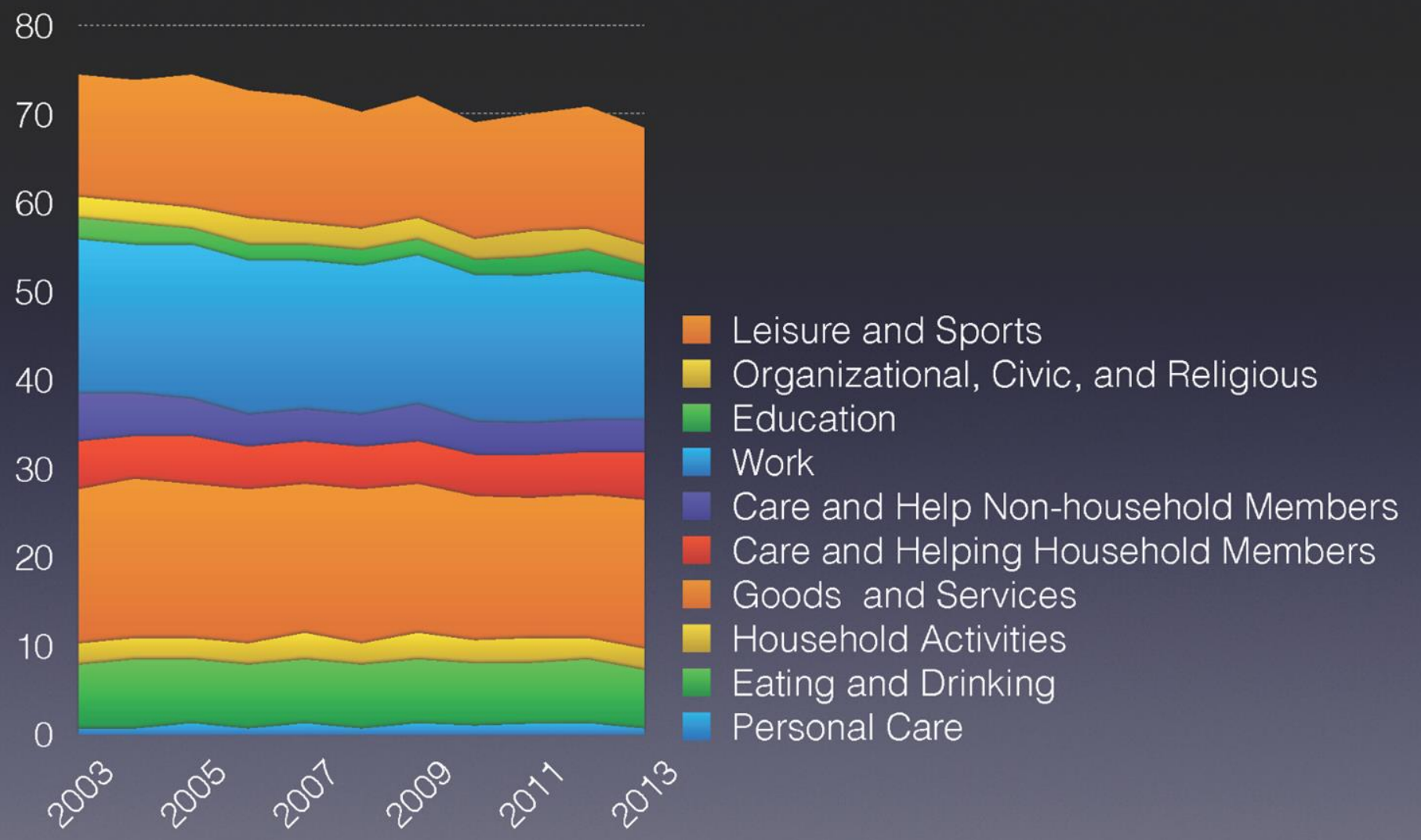
Source: Based on Bureau of Transportation Statistics (2015) National Transportation Statistics
Table 1-4: Public Road and Street Mileage in the United States by Type of Surface(a) (Thousands of miles). http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_04.html

Figure 1.3 Registered motor vehicles in US



Source: US Census Bureau. Statistical Abstract of the United States and Historical Statistical Abstract of the United States http://www.census.gov/compendia/statab/past_years.html

Figure 1.4 Total Time Spent Traveling per capita (minutes)



Source: US Bureau of Labor Statistics - American Time Use Survey (various years) http://www.bls.gov/tus/

What Killed America's Traffic?

David Levinson
University of Minnesota

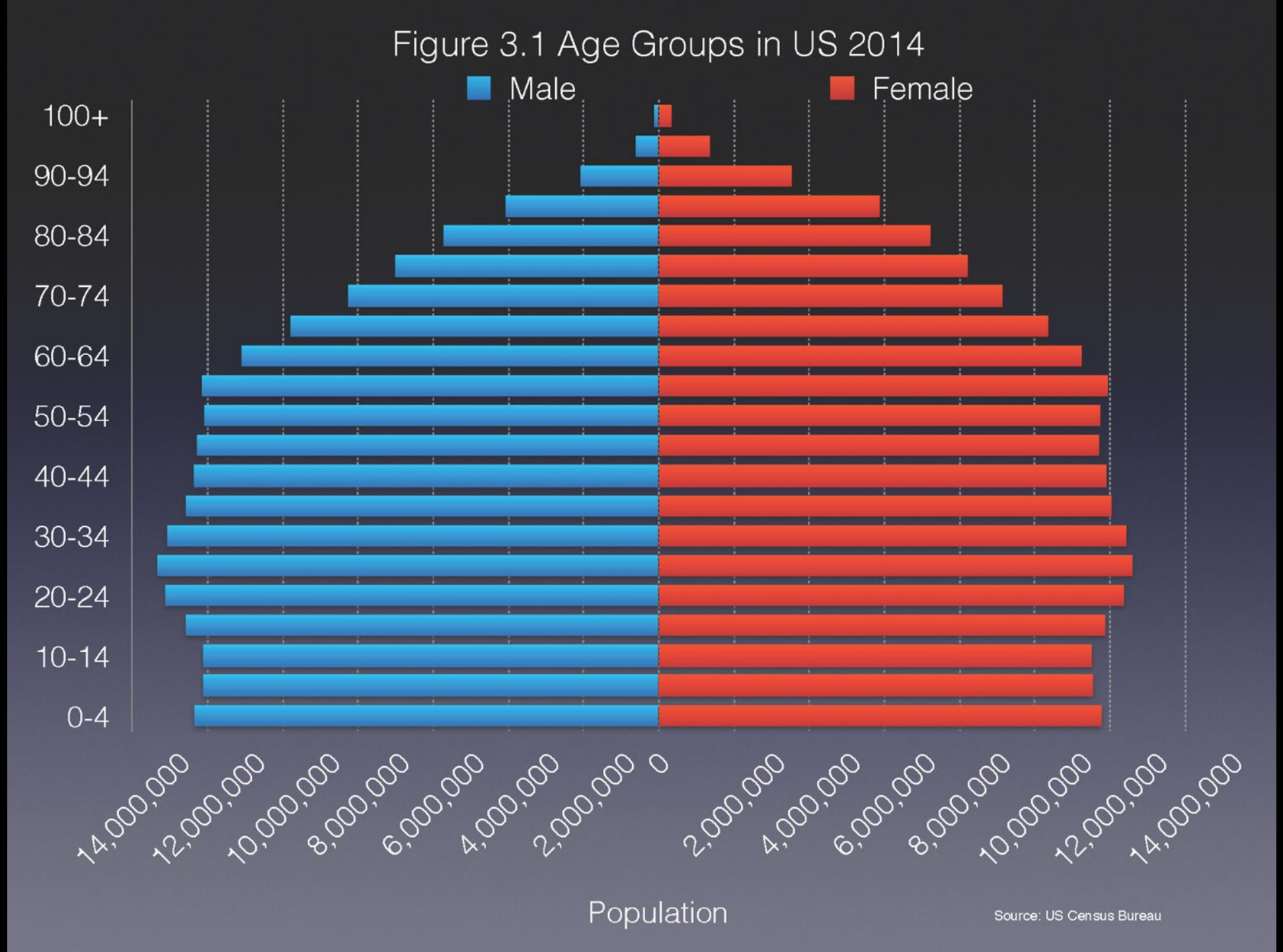
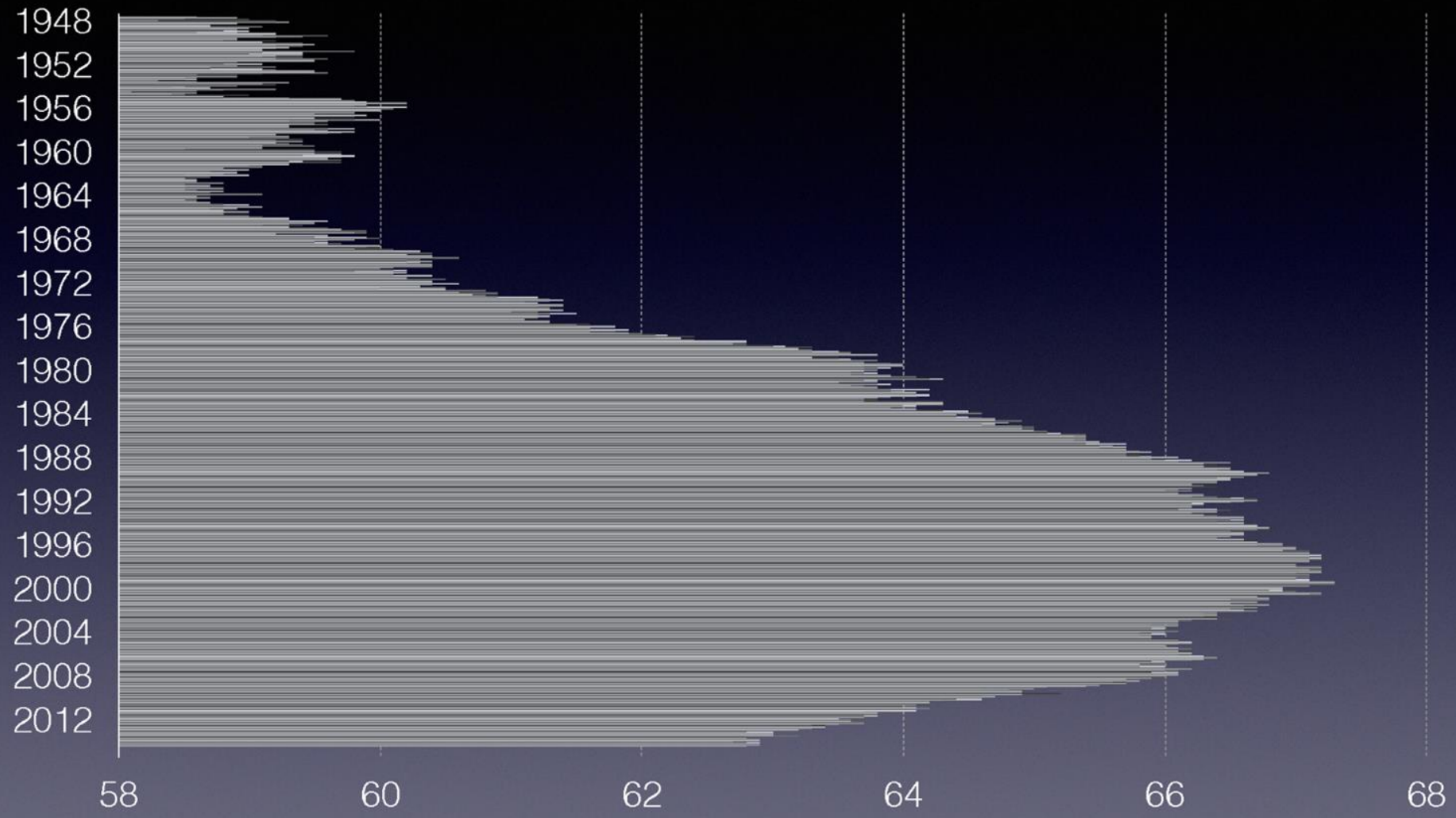


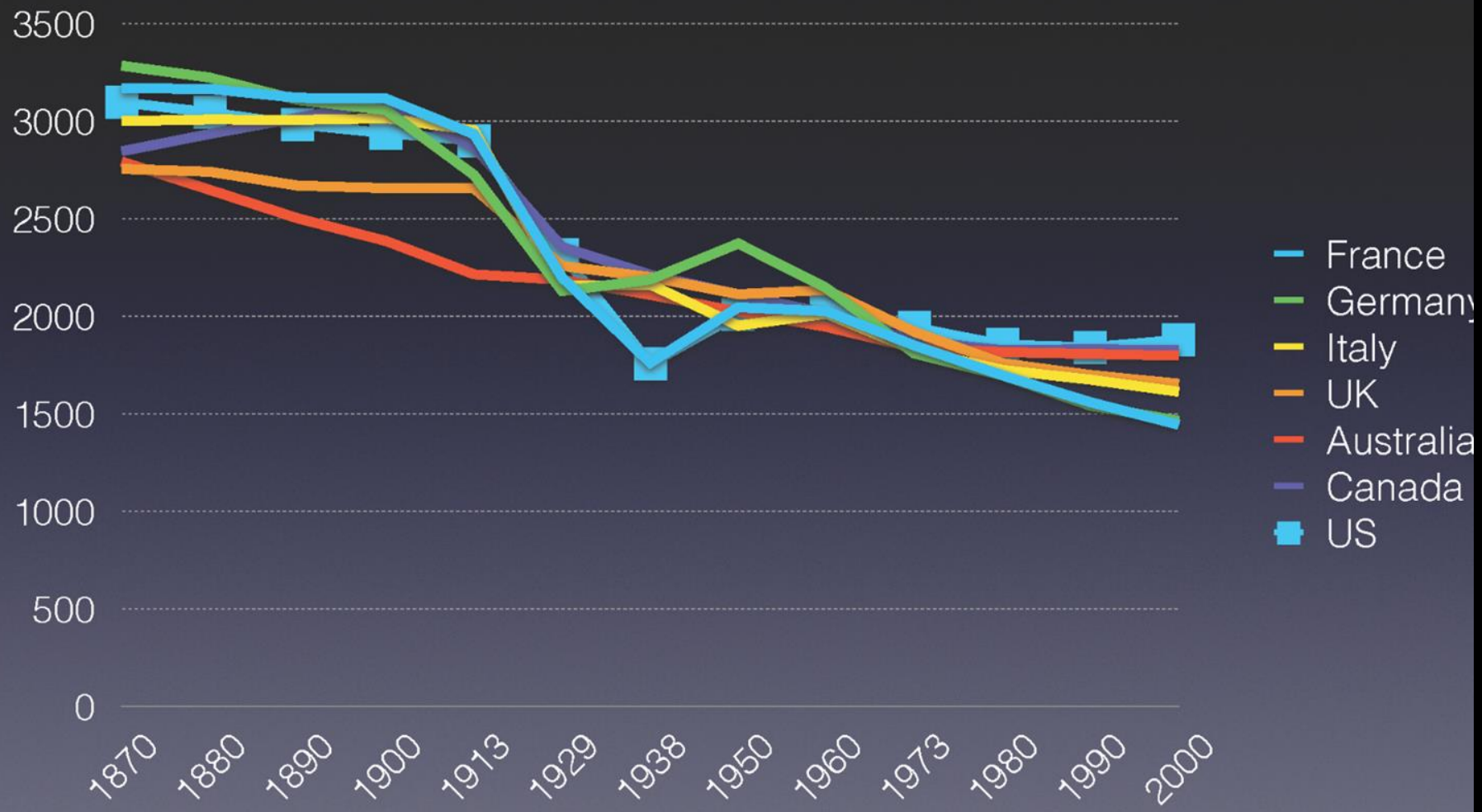
Figure 3.1 Age Groups in US 2014
Male
Female
100+
90-94
80-84
70-74
60-64
50-54
40-44
30-34
20-24
10-14
0-4
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
14,000,000
Population
Source: US Census Bureau

Figure 3.2 US Labor Force Participation Rate: 1948-2015



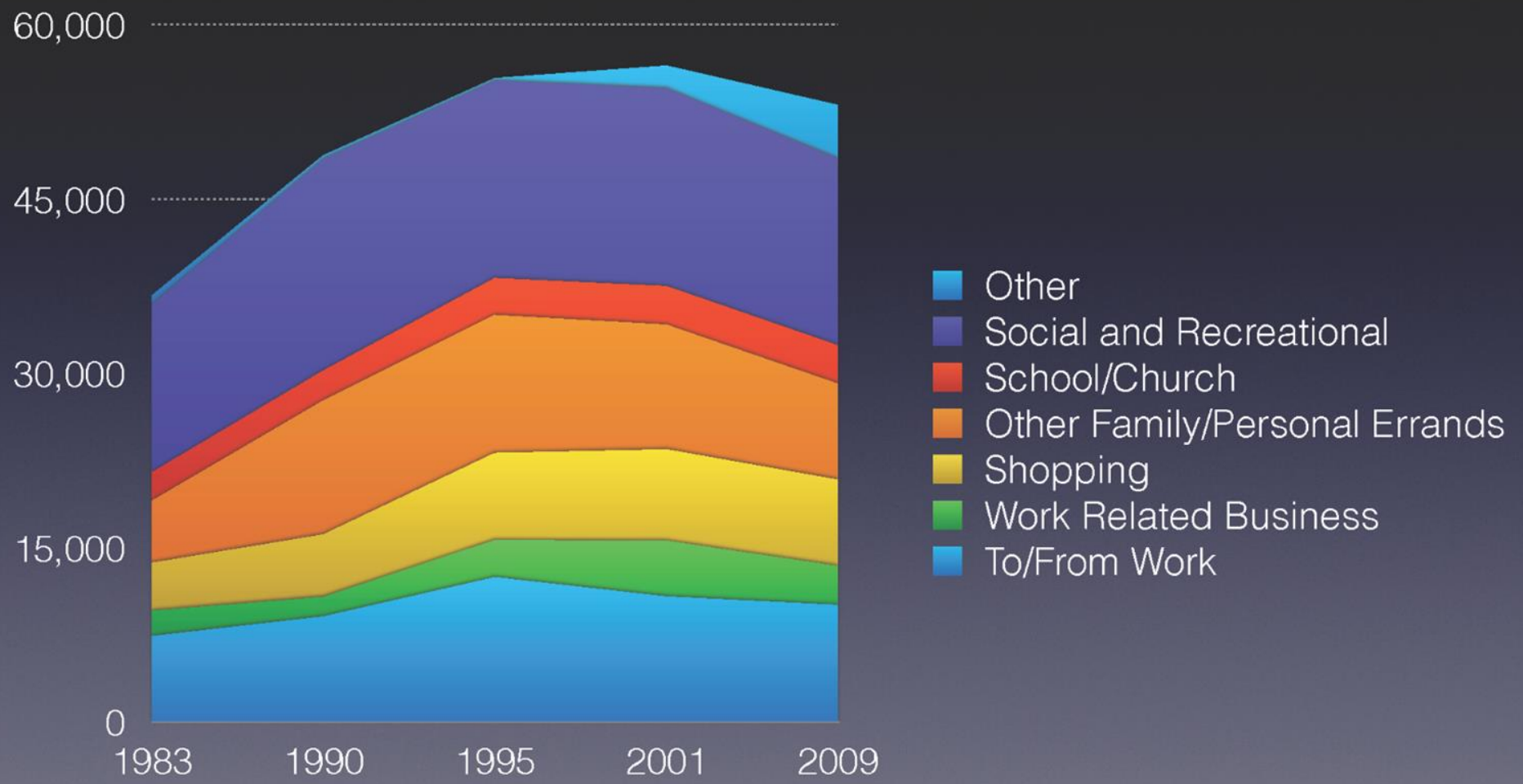
Source; US Department of Labor - Bureau of Labor Statistics (2015) Labor Force Statistics from the Current Population Survey http://data.bls.gov/timeseries/LNS11300000

Figure 3.3 Annual Hours of Work: 1870-2000



Source: Huberman & Minns (2007) – The times they are not changin': Days and hours of work in Old and New Worlds, 1870–2000. Explorations in Economic History, 44(4):538–567. via Max Roser Our World in Data http://ourworldindata.org/data/economic-development-

Figure 3.7 Travel by Purpose per capita (km)



Source: Table 5: Summary of Travel Trends, 2009 National Household Travel Survey) http://nhts.ornl.gov/2009/pub/stt.pdf

Figure 3.8 Proportion of Population with a Driver's License by Age and and Year of Birth Cohort

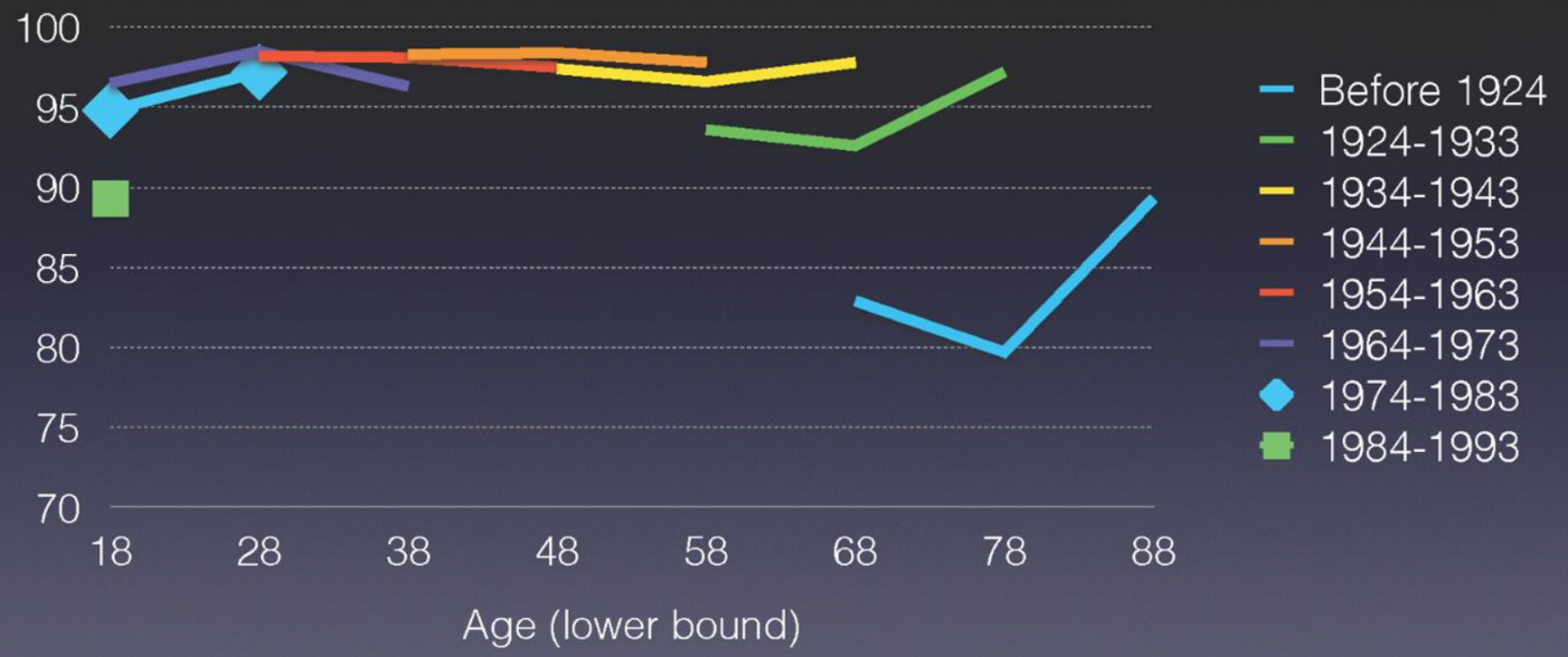


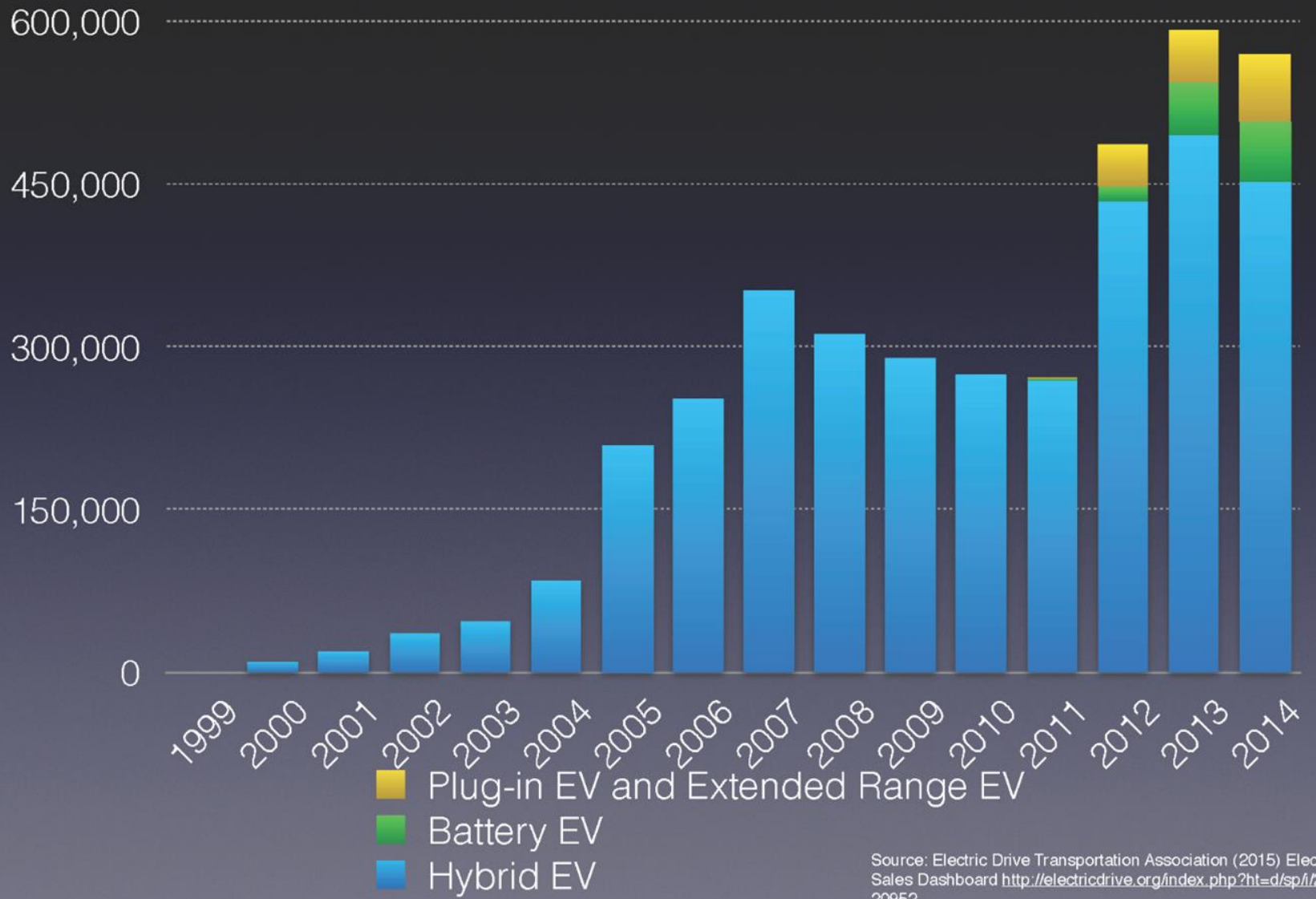
Figure 3.9 US Retail Gasoline Price (Dollars per Gallon)

Source: US Energy Information Administration http://www.eia.gov/petroleum/gasdiesel/

The Transition to Electric Vehicles

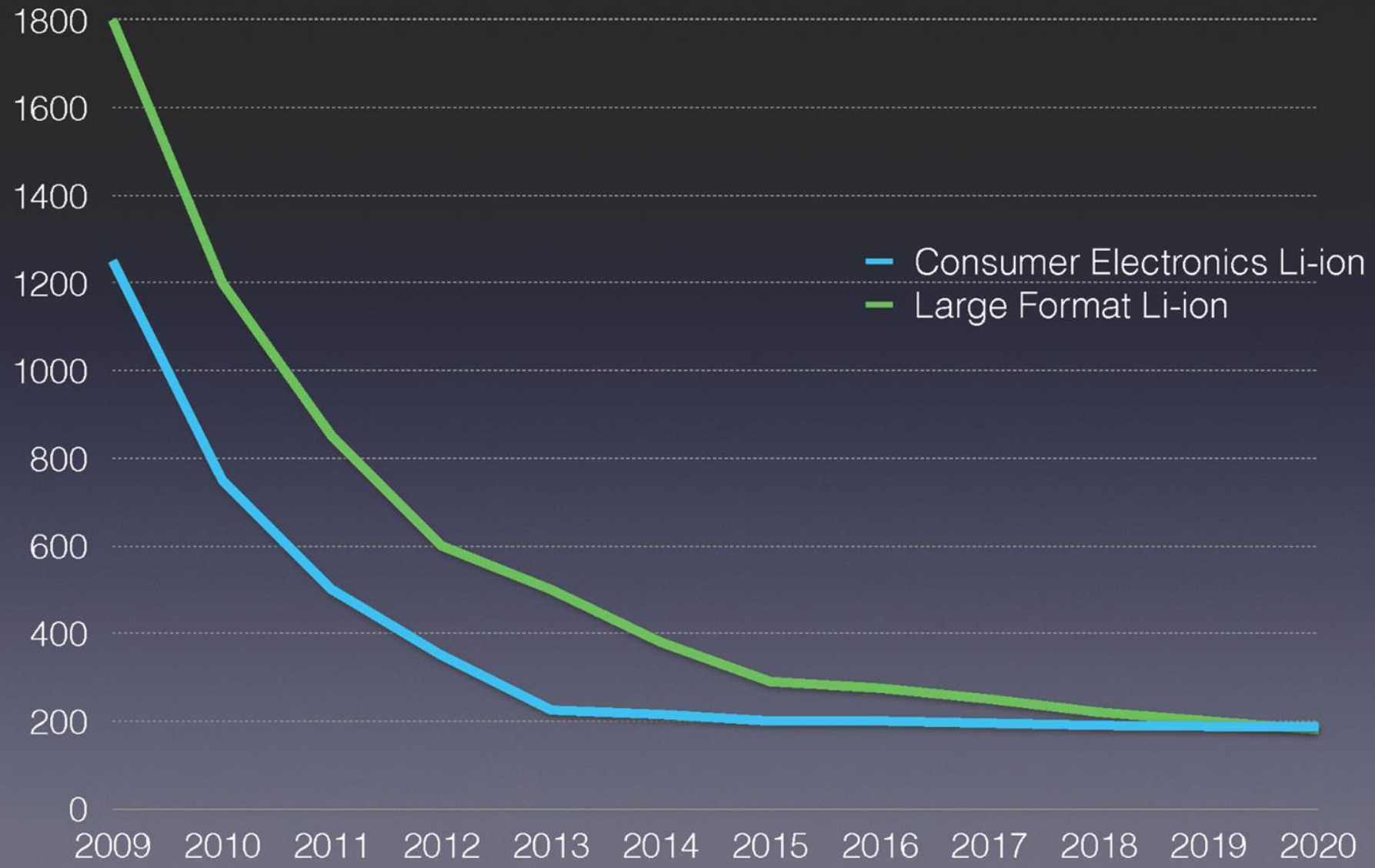
David Levinson
University of Minnesota

Figure 5.1 US Sales of Electric Vehicles



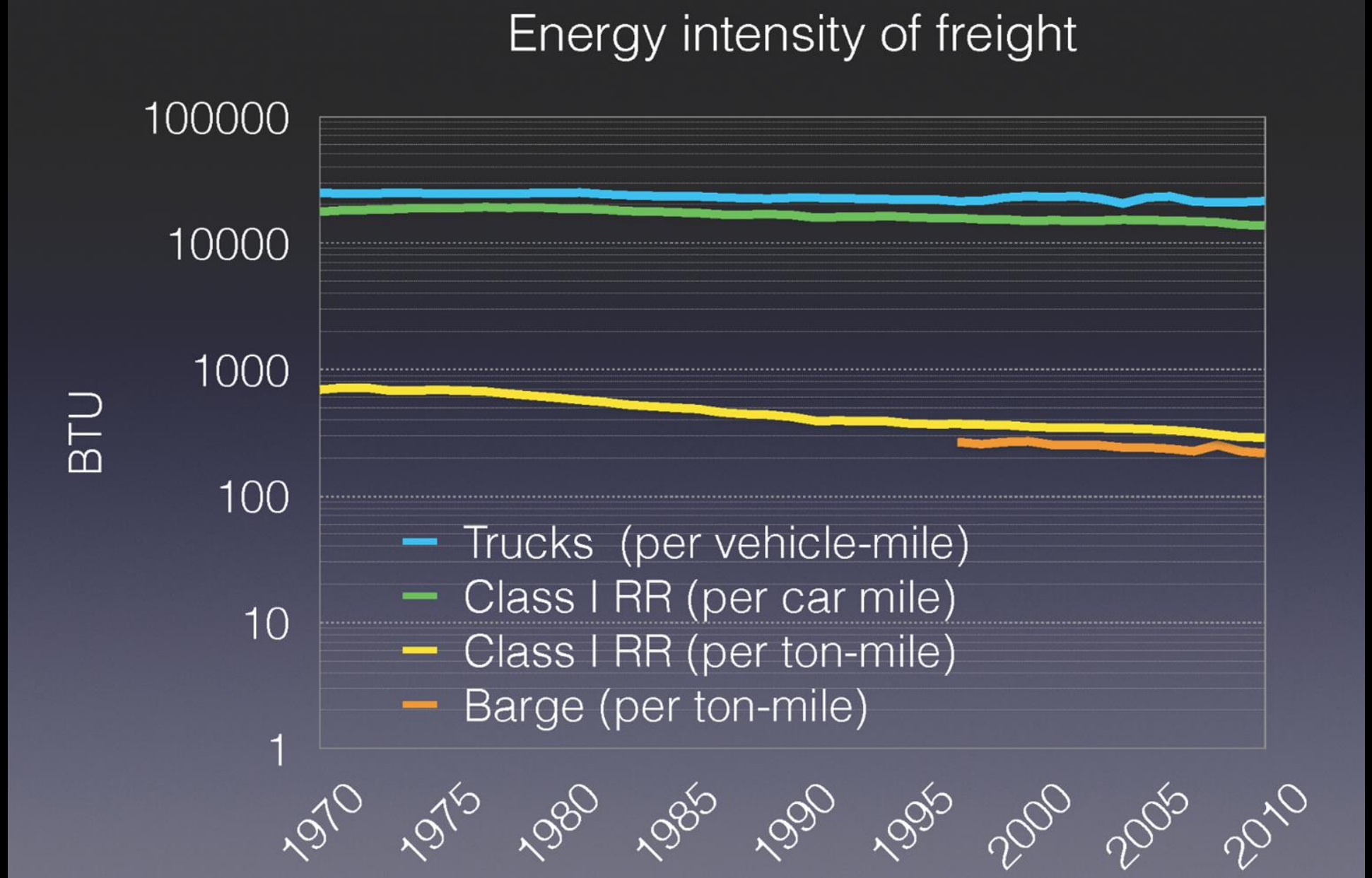
Source: Electric Drive Transportation Association (2015) Electric Drive Sales Dashboard http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952

Figure 5.2 Lithium Ion Battery Pricing by Cell Type (2009-2020) ($/kWh)



Source: Navigate Research: Jaffe, Sam (2014-01-28) "The Lithium Ion Battery Market Supply and Demand". ARPA E RANGE Conference http://www.arpa-e.energy.gov/sites/default/files/documents/files/Jaffe_RANGE_Kickoff_2014.pdf

Figure 5.3: Car2Go carsharing vehicles are Smart Fortwos, the smallest car sold on the US Market. While generally Car2Go is allowed to park on-street on City of Minneapolis roads, this poor car received a ticket as it was parked on a road maintained by the press Department, a separate unit of government. A distinction without a difference for most Minneapolitans. Photo by David Levinson


Energy intensity of freight
100000
10000
1000
100
10
1
BTU
Trucks (per vehicle-mile)
Class I RR (per car mile)
Class I RR (per ton-mile)
Barge (per ton-mile)
1970
1975
1980
1985
1990
1995
2000
2005
2010

Innovation

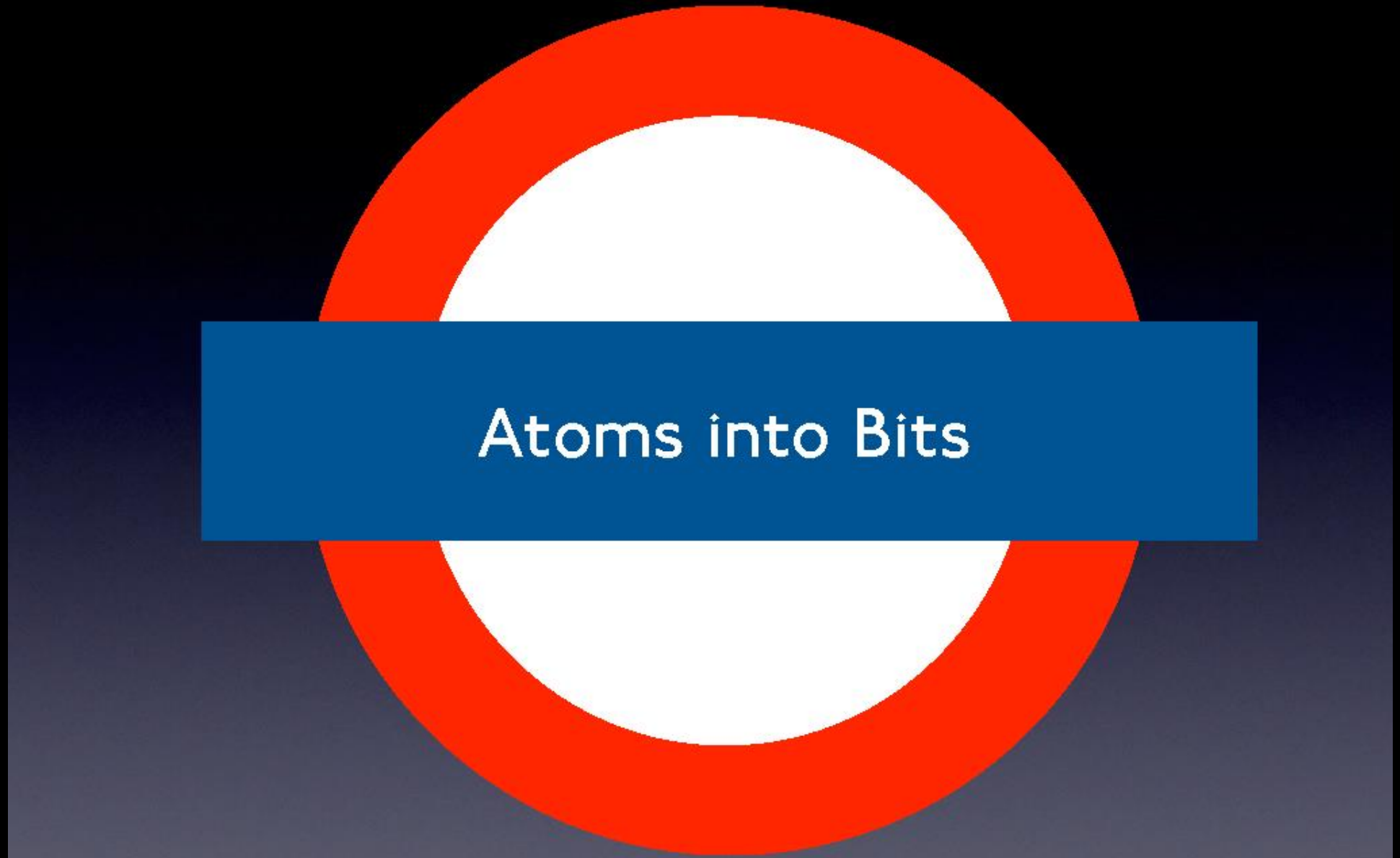
- ~10x improvement on some relevant dimension to justify switching energy platform
- Relevant dimensions: Cost, Speed, Size, Pollution, Comfort, Range

Methanol

- Methanol from drilling etc. doesn't fully address CO2.
- Biofuels are expensive
- Petroleum is abundant and infrastructure exists
- Electricity/batteries/fuel cells are getting steadily better
- Cars are getting more efficient
- Travel demand in US is dropping

Implications

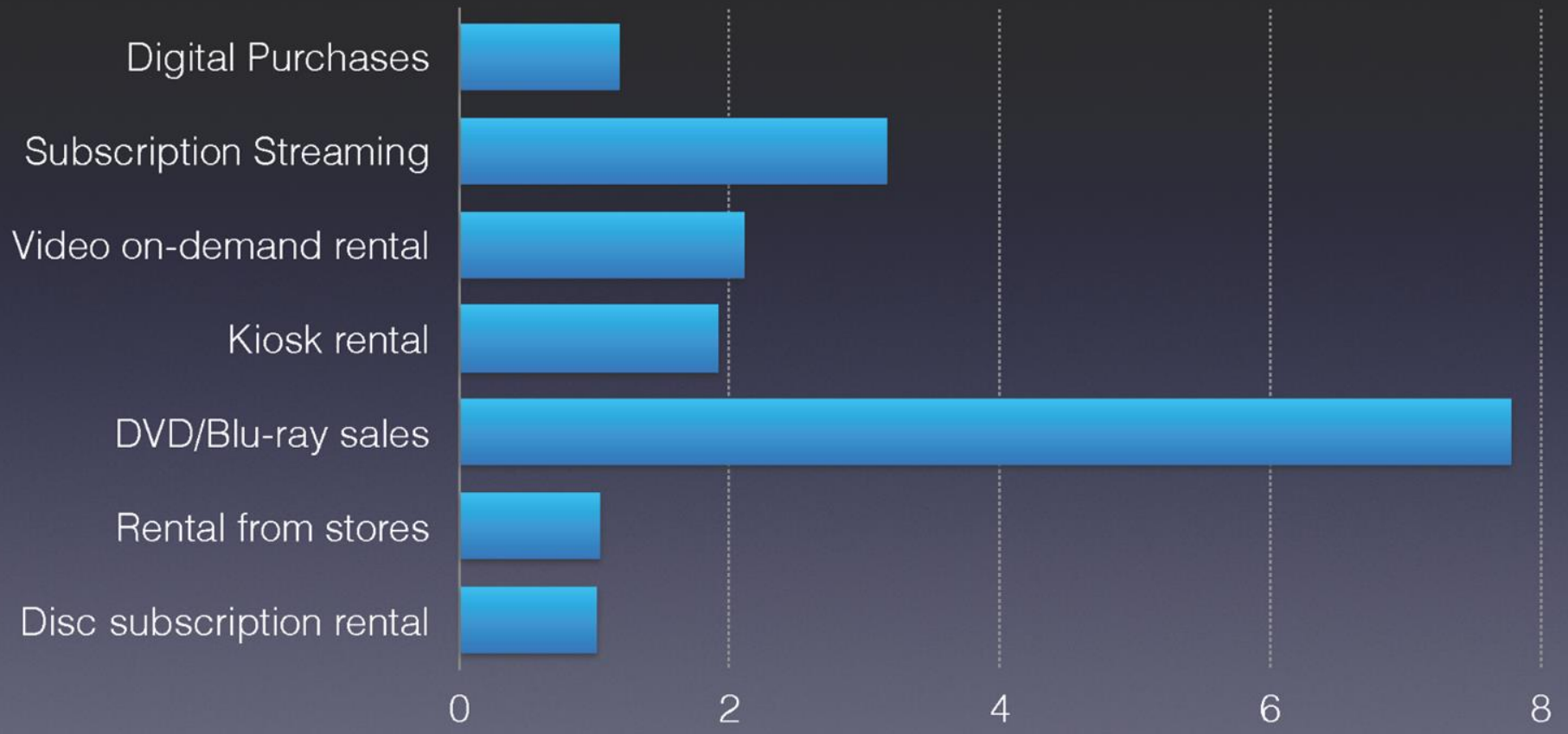
- Fewer Fuel Trucks
- Electric Trucks? (Later than Cars for widespread adoption)
- Alternative Fuels (CNG, etc.)



Atoms into Bits

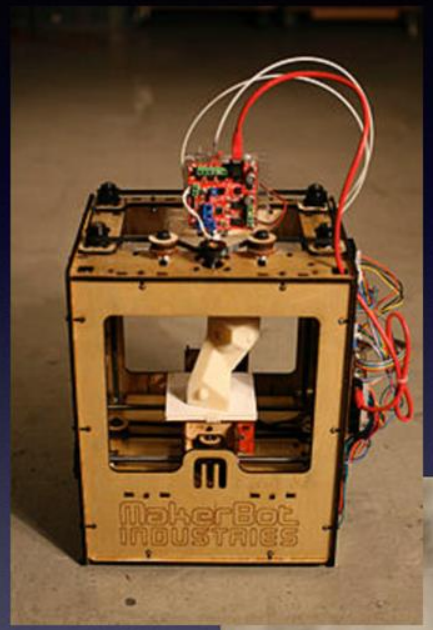
David Levinson
University of Minnesota

Figure 6.1 US Home Entertainment Revenue (2013 $B)

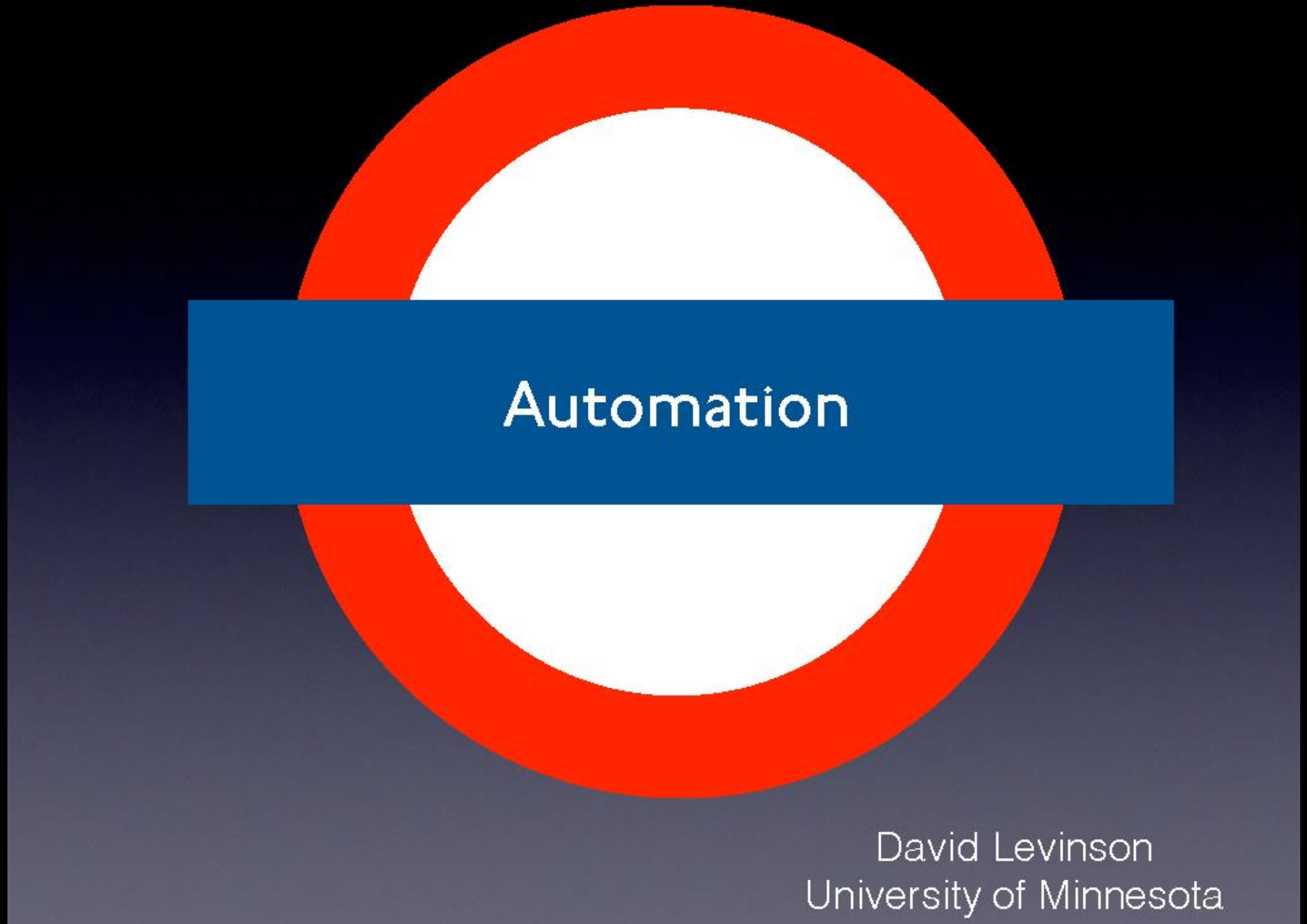


Source: Wall Street Journal and Digital Entertainment Group Fritz, Ben (2014) Sales of Digital Movies Surge. Wall Street Journal. 2014-01-07 http://www.wsj.com/news/articles/SB10001424052702304887104579306440621142958

3-D Printing

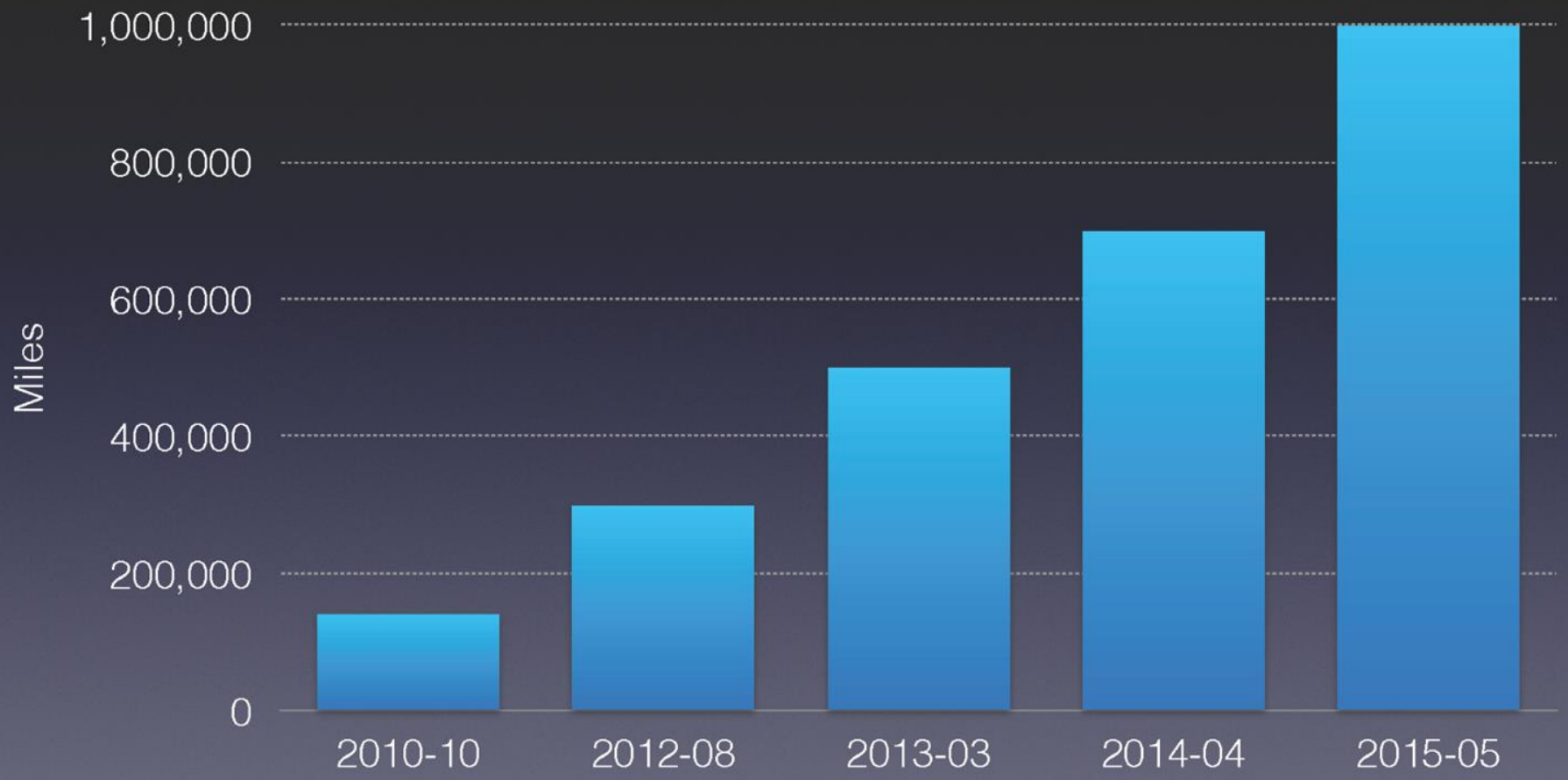


all photos wikipedia: 3D Printing, Soda Fountain



David Levinson
University of Minnesota

Figure 7.1 Cumulative miles traveled by Google Autonomous Vehicles



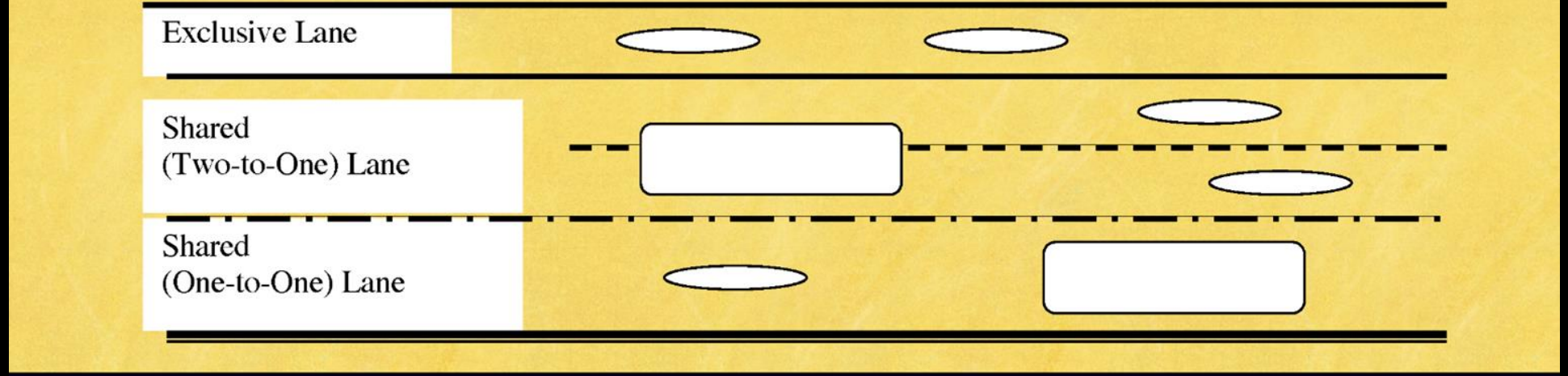
Source: Data on Google Cars from
140,000 - http://googleblog.blogspot.com/2010/10/what-were-driving-at.html
300,000 http://googleblog.blogspot.com/2012/08/the-self-driving-car-logs-more-miles-on.html
500,000 http://www.businessinsider.com/google-self-driving-car-problems-2013-3?op=1
700,000 http://googleblog.blogspot.co.uk/2014/04/the-latest-chapter-for-self-driving-car.html
Nearly a million http://googleblog.blogspot.com/2015/05/self-driving-vehicle-prototypes-on-road.html

Autonomous trucks

- One driver (in a control center) remotely “drives” (supervises) many drone trucks on set routes.
- He intervenes if something goes wrong.
- He is bored.

Maximum Homerdrive

- The Simpson's Episode 220 (1999)

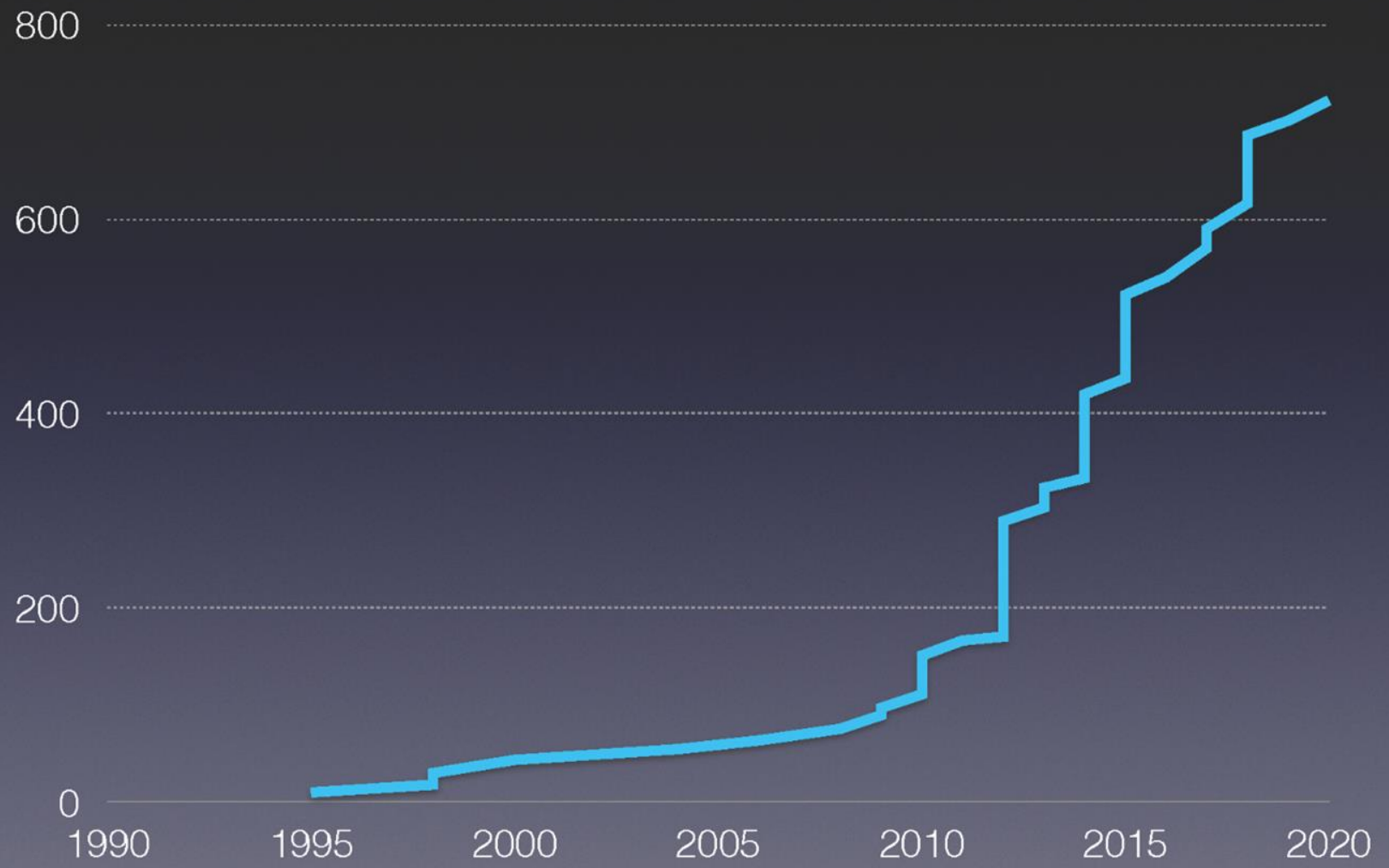


Alternative Vehicles, Alternative Highways

Pricing

David Levinson
University of Minnesota

Figure 13.1 Cumulative Mileage of HOT Lanes in United States



Sources various. Special thanks to David Ungemah and Mark Burris.

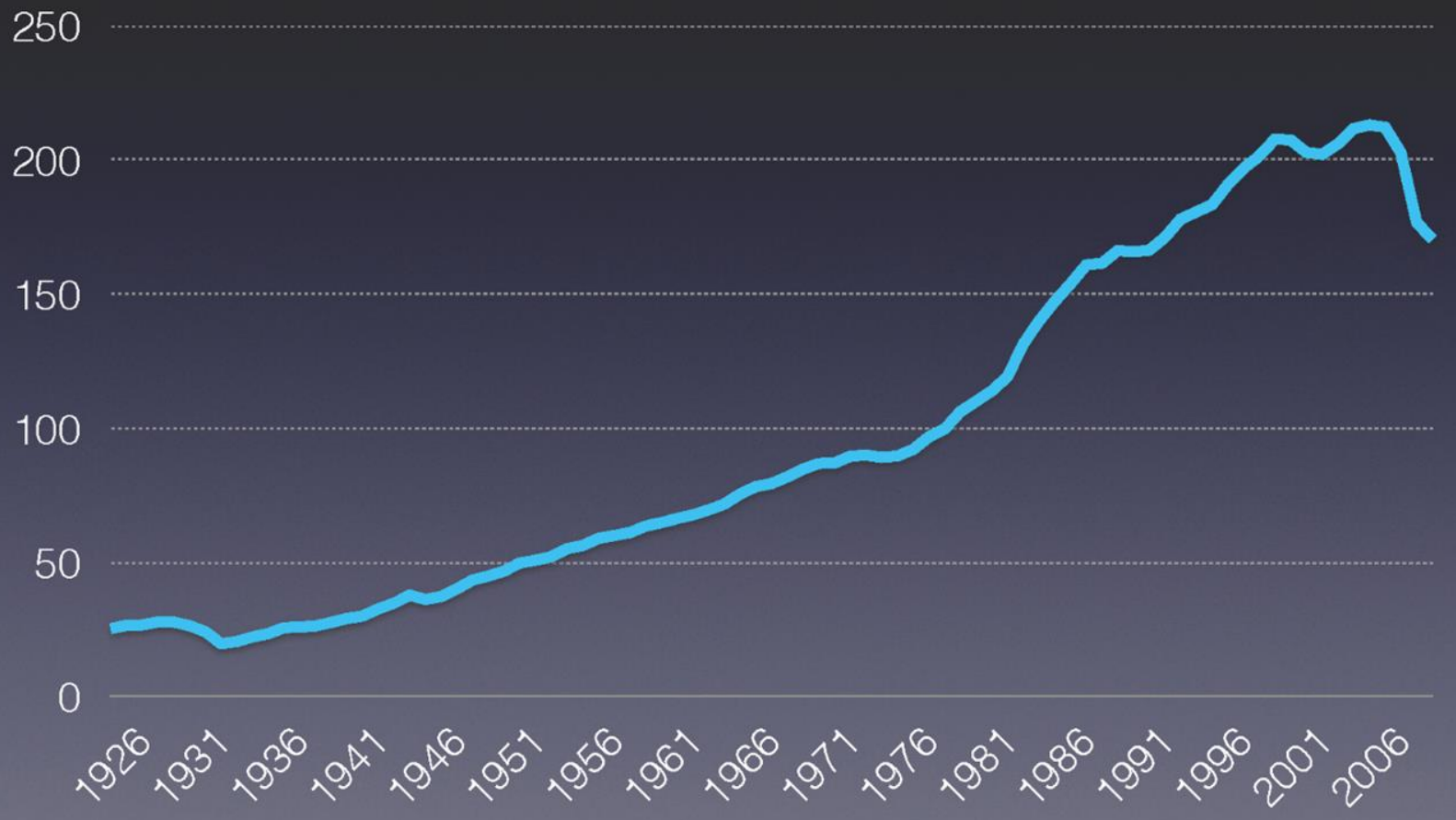
Public Strategies

- Gas Tax
- EV -> Vehicle Mileage Tax
- Vary Tax by Time and Place (price out some trips, reduce congestion)
- Networks of HOT Lanes
- Networks of Truck only Toll Lanes ???

Freight

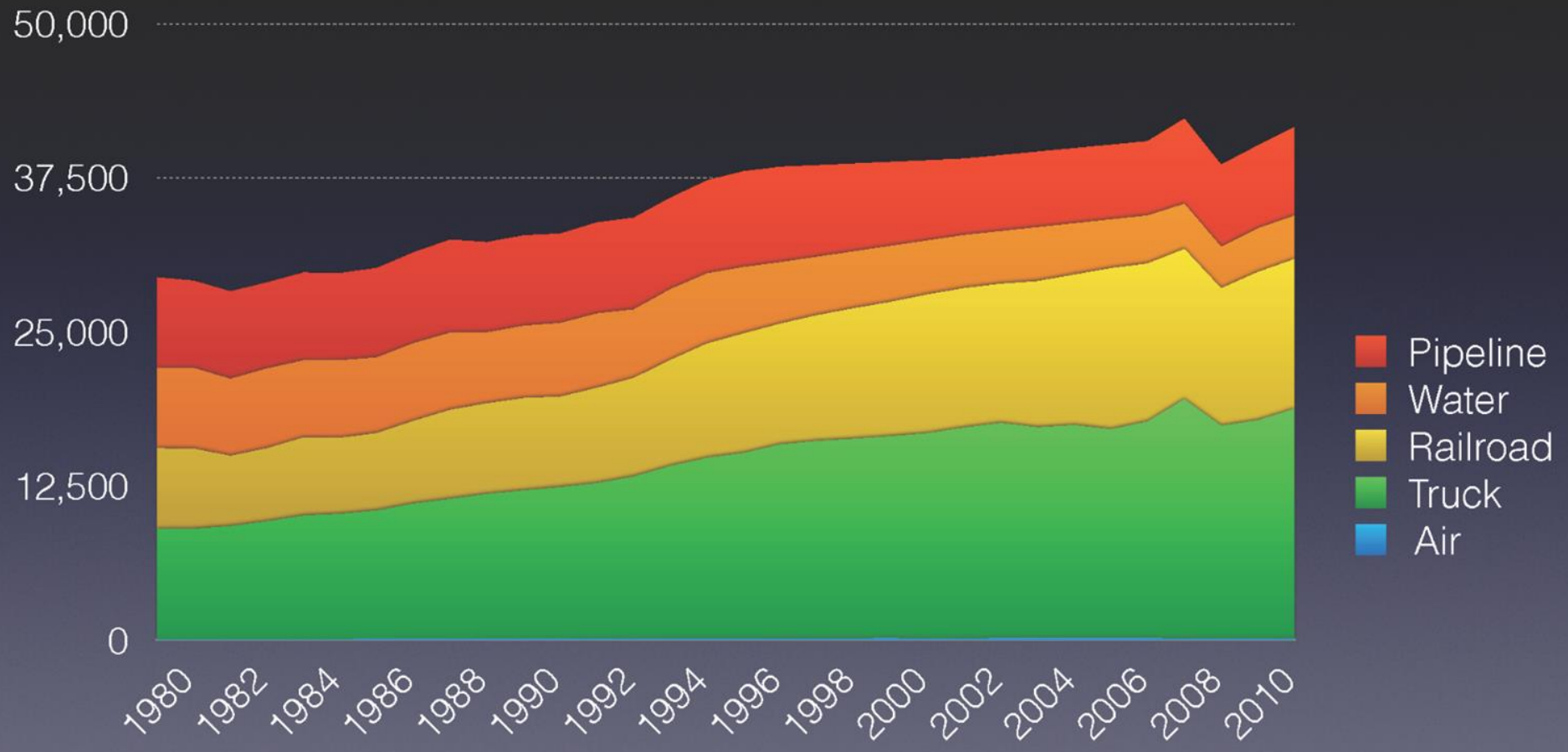
David Levinson
University of Minnesota

Figure 3.11 Billions of Pieces of Mail Handled Per Year: US Post (1926-2009)



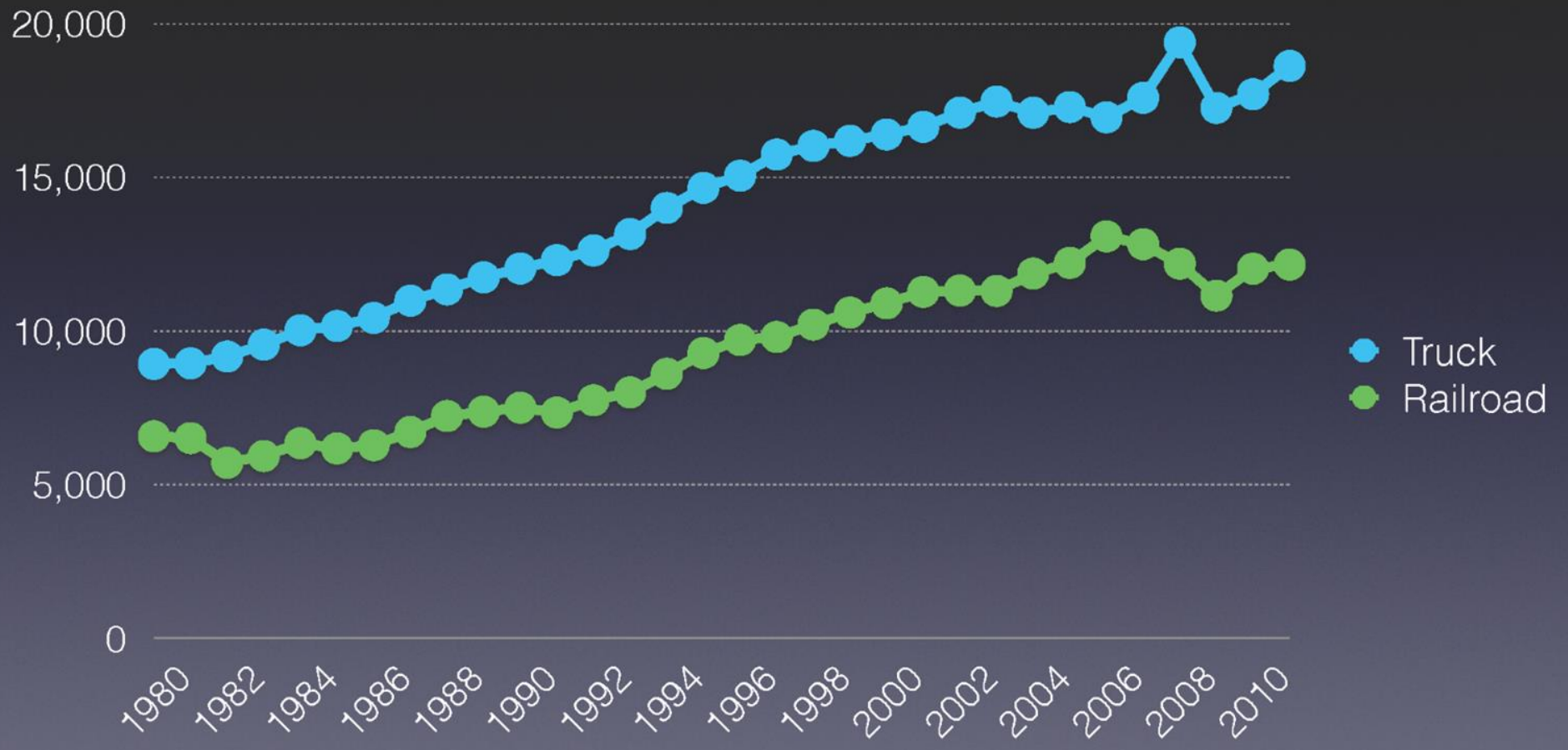
Source: US Postal Service (nd) Pieces of Mail Handled, Number of Post Offices, Income, and Expenses Since 1789.
https://about.usps.com/who-we-are/postal-history/pieces-of-mail-since-1789.htm

Figure 3.6 US Ton-km of Domestic Freight by Mode (Per Capita)



Source: US Bureau of Transportation Statistics National Transportation Statistics
Table 1-50: U.S. Ton-Miles of Freight (BTS Special Tabulation) (Millions) http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_50.html

Figure 3.6 US Ton-km of Domestic Freight: Rail vs. Truck (Per Capita)



Source: US Bureau of Transportation Statistics National Transportation Statistics
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Expectations

- Rail will drop in the future as coal is phased out
- Truck may grow with population (< 1%), and for last mile with substitution of delivery for shopping, not much faster due to dematerialization and shrinking size of goods.

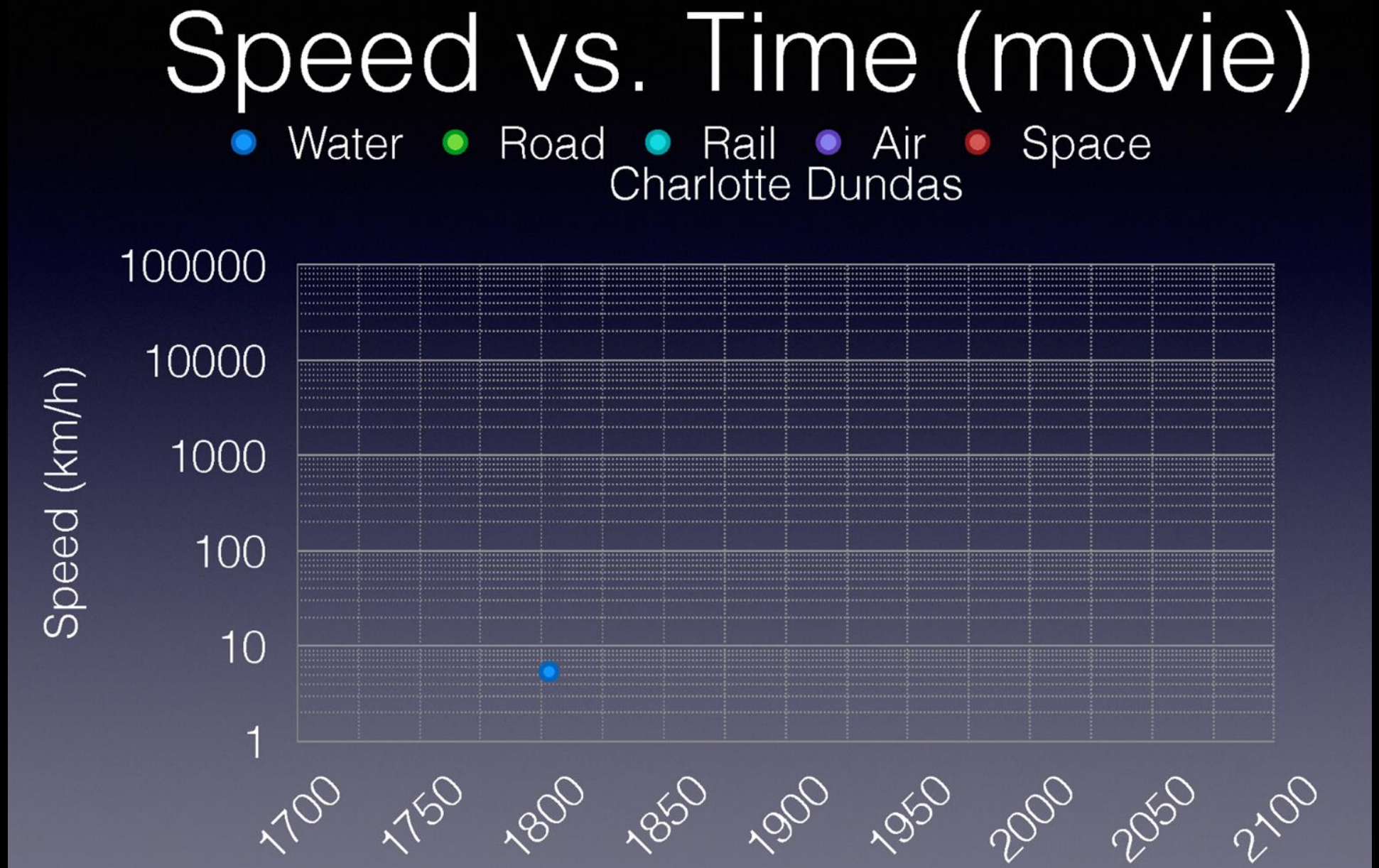
Upcoming Directions

- Supply Chain Network Pooling
- Physical Internet
- B2B: Near Real-Time (Same Day, Same Hour Delivery)
- B2C: Near Real-Time
- Peer-to-Peer Delivery
- Consolidated Home Delivery

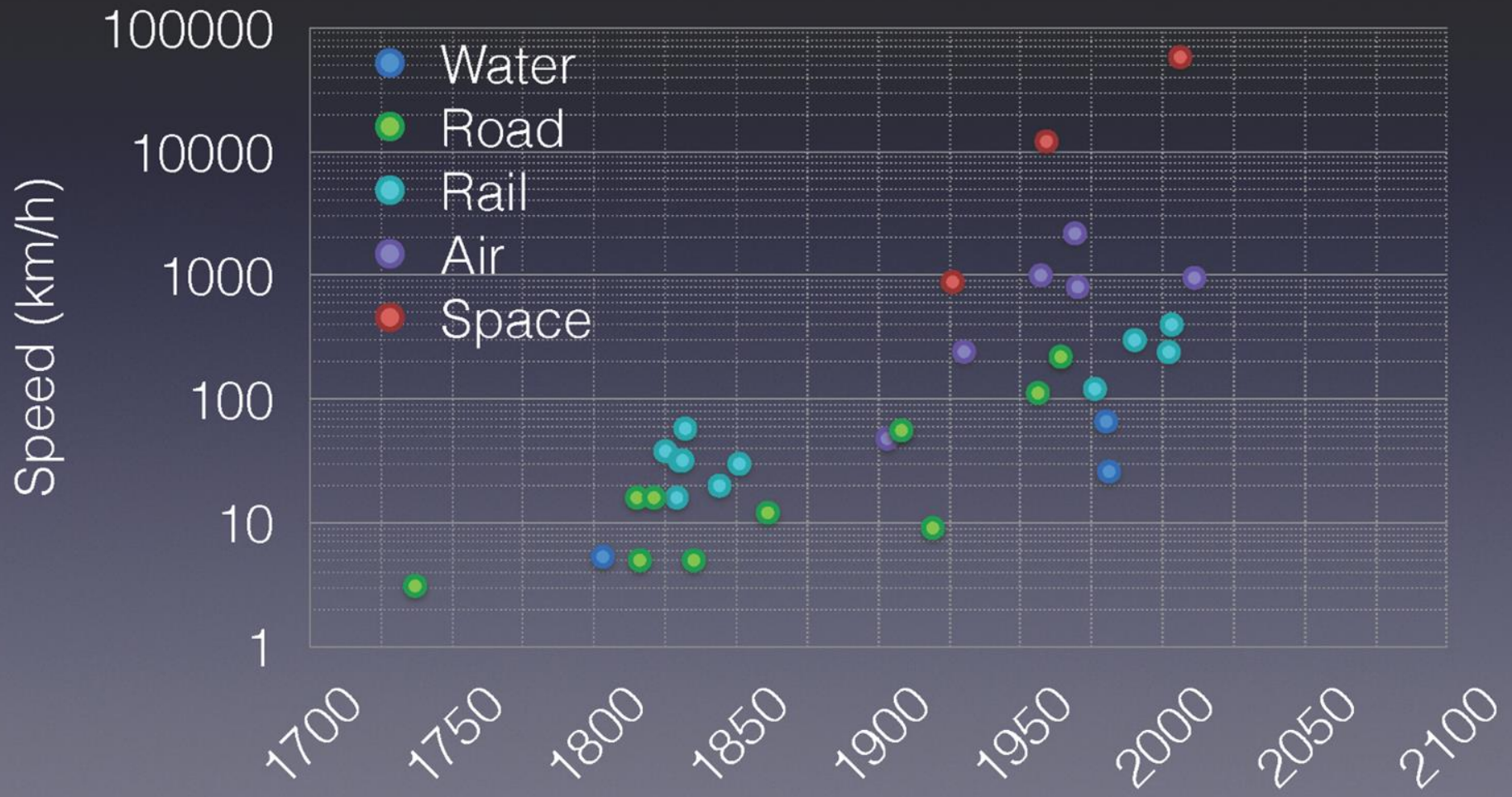
Speed

David Levinson
University of Minnesota

Speed vs. Time (movie)



Speed vs. Time



Thank you

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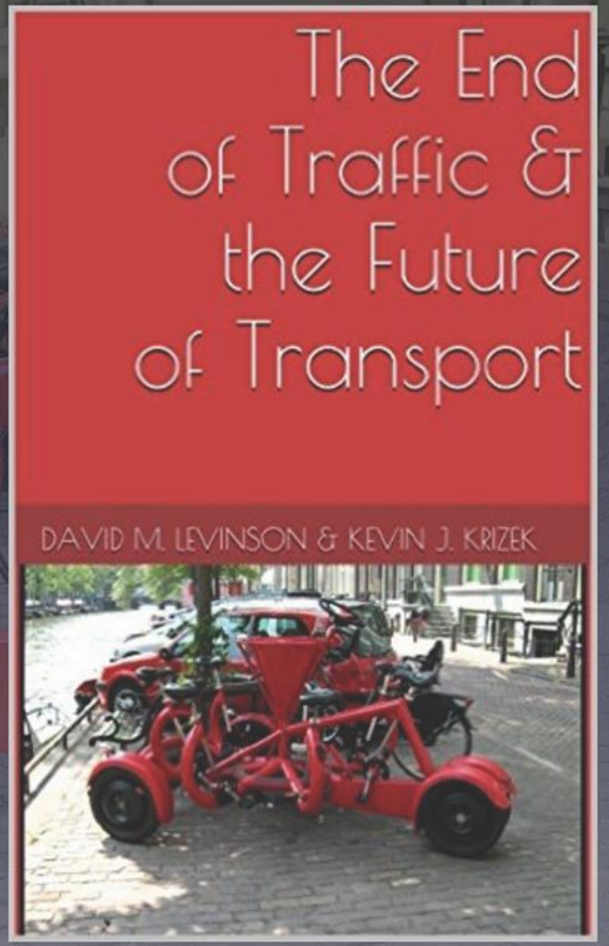
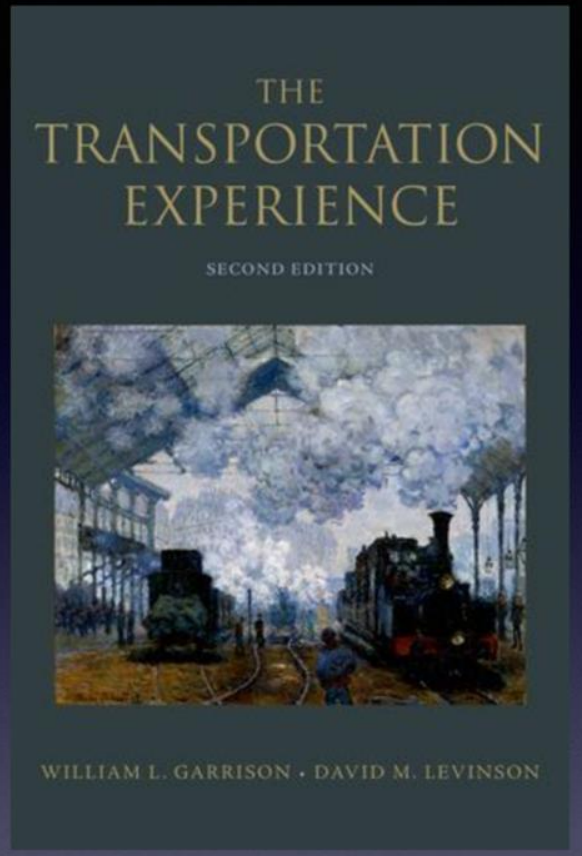


Burning Questions

http://www.hclib.org/pub/search/specialcollections/mplshistory/?id=10



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Trucking's Future Now

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FREIGHT INFRASTRUCTURE

COMMERCIAL VEHICLE OUTLOOK

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How Modes Have Evolved

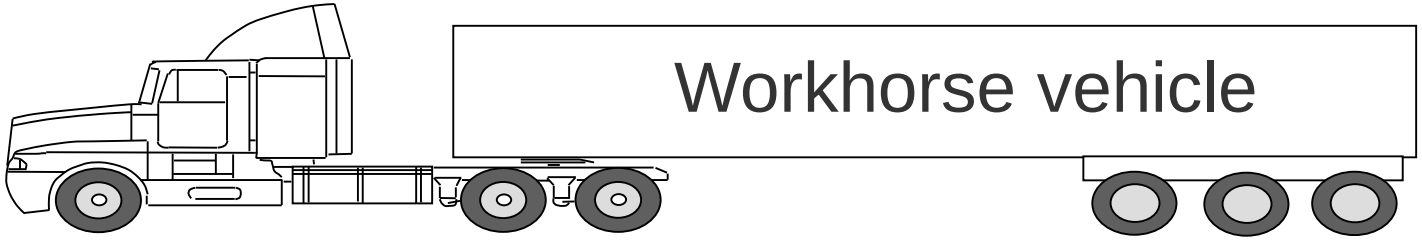
- Container ships have doubled in capacity in 13 years
- Rail axle weights have increased from 263,000 lbs in 1991 to 315,000 lbs today
- 70% of Rail intermodal containers are double stacked
- Federal truck size and weight have been frozen for over 30 years
- Other countries have evolved their policies

International Comparison

Canada	European Union
6-axle tractor semi-trailer 102,500 lb 8-axle B-train double 137,800 lb	6-axle tractor semi-trailer Typical 97,000 lb 105,800 lb (Denmark)

United States	Australia
(Interstate and NHS limits) 5-axle tractor semi-trailer 80,000 lb 7-axle tractor twin-trailer 80,000 lb	6-axle tractor semi-trailer 101,400 lb B-train doubles 151,000 lb (approved routes)

Mexico	New Zealand
6-axle tractor semi-trailer 105,800 lb 8-axle B-train double 138,000 lb	6-axle tractor semi-trailer 86,000 lb B-train doubles 97,000 lb or 110,200 lb Up to 136,700 lb specific routes for High productivity motor vehicles (HPMV)



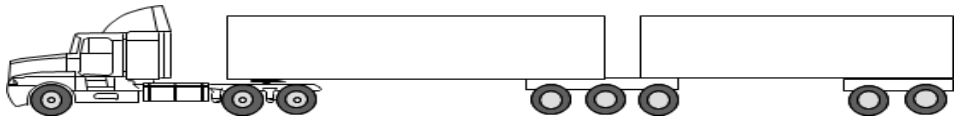
Workhorse vehicle

Country	Steer	Drive	Tridem	GVW	Productivity advantage Relative to USA
	(lb)	(lb)	(lb)	(lb)	
South Africa	17,000	39,700	52,900	109,600	**59%**
Mexico	*14,300*	*43,000*	*49,600*	*106,900*	**53%**
Denmark	17,600	35,300	52,900	105,800	**51%**
Canada	*12,100*	*37,500*	*52,900*	*102,500*	**44%**
Australia	14,300	37,500	49,600	101,400	**41%**
UK	13,900	35,300	47,400	96,600	**32%**
USA	*12,000*	*34,000*	*34,000**	*80,000*	**----**

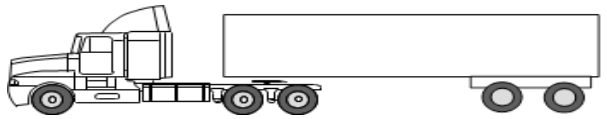
Assumed empty weight 36,400 lb for 6-axle
* 34,000 lb for US 5-axle vehicle

Woodrooffe

Productivity Comparison



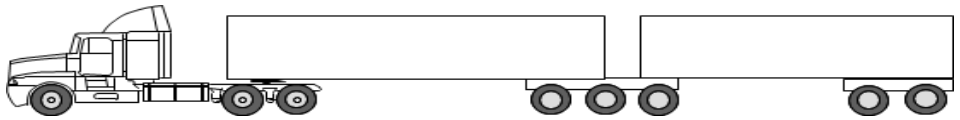
Canadian B-train



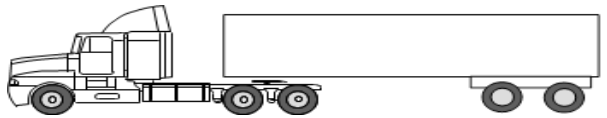
US Tractor semitrailer

Country & Vehicle	GVW	Number of axles	Payload	Productivity Advantage
Canada 8-axle B-Train	137,800 lbs	8	93,000 lbs	Factor of 2
US Tractor semi	80,000 lbs	5	46,100 lbs	-

Fuel & GHG Comparison
Unrestricted Access Vehicles



Canadian B-train



US Tractor semitrailer

Country & Vehicle	Cargo unit Fuel (liter/tonne-km)	Cargo unit CO_2 (g CO_2/tonne-km)	Fuel and GHG Advantage per unit cargo
Canada B-Train	0.037	98.79	68%
US Tractor semi	0.063	165.9	-

10% Reduction in Truck VMT

Benefit study variable	Injury severity	Reductions assuming 10%reduction in exposure	Estimated annual benefits ($US Billion)
Estimated safety benefits attributed to a 10% reduction in truck travel distance	no apparent injury	21562	0.20
	possible injury	2,929	0.44
	evident injury	2,724	0.68
	disabling injury	1,453	0.87
	Killed	330	2.54
	Total safety cost saving attributed to 10% reduction in exposure		**4.73**
Estimated fuel and emissions benefits attributed to a 10% reduction in truck travel distance	Category	Quantity saved	Annual cost saving ($US Billion)
	Diesel fuel reduction	10.6 billion liters	10.60
	CO2 reduction	28.3 Million metric tons CO2	0.680
Combined benefits	**Total estimated annual savings**		**16.01**

Comparing Estimated Annual Safety Benefits

Assumes 100% ESC and F-Cam Fleet Penetration
Assumes 10% Reduction in VMT from Size and Weight Reform

Crash Avoidance Option	Annual Fatality Reduction	Annual Injury Reduction
ESC	126	5,909
F-CAM (2nd gen)	99	3,590
Size & Weight Regulation reform	330	7,106

Size and Weight Reform as a Safety Strategy

Trucking's Future Now

ROBERT KREEB

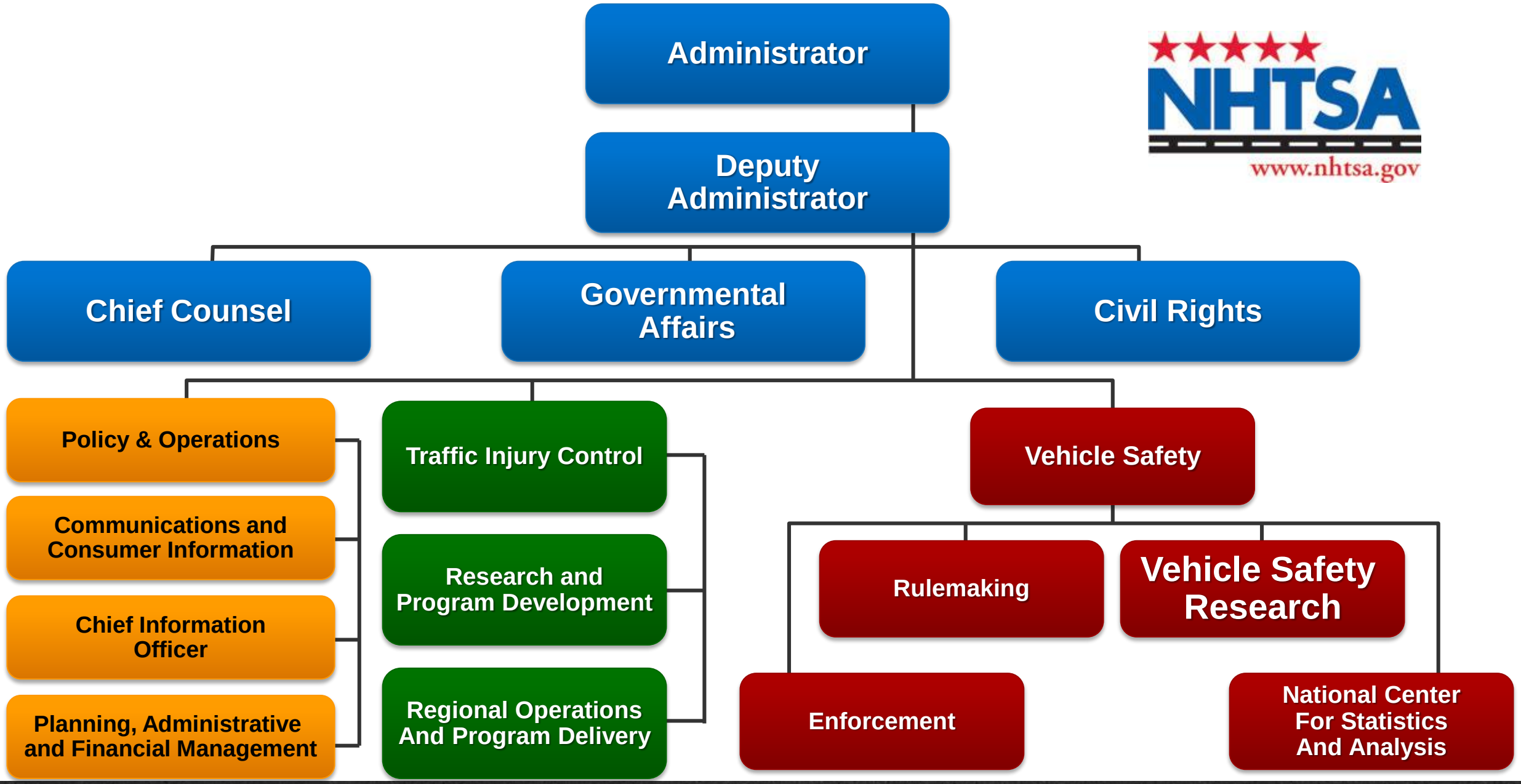
Chief: Intelligent Technologies Research Division

NHTSA Heavy Vehicle Safety Research

FREIGHT INFRASTRUCTURE

COMMERCIAL VEHICLE OUTLOOK

Text Questions for the Speakers to: 862-781-0001.



NHTSA
www.nhtsa.gov

Office of Crash Avoidance & Electronic Controls

- Connected Vehicles
- Crash Avoidance Systems
- Automated Vehicles
- Vehicle Cyber-security
- Electronic Systems Reliability
- Human Factors

NHTSA Heavy Vehicle Crash Avoidance Research

- Electronic Stability Control
- Forward Collision Warning and Automatic Emergency Braking
- Lane Departure Warning
- Collision Warning Interfaces
- Vehicle to Vehicle Communications
- Heavy Vehicle Cybersecurity Vulnerability Profile
- Heavy Vehicle Functional Safety Assessment Profile (application of ISO 26262 to heavy vehicles)

Crash Worthiness Research

- Tractor Cab Crashworthiness
  - (Report to Congress in May)
- Underride Guards for trailers
  - Regulatory proposal announced for 2015
- Single Unit Truck Conspicuity: ANPRM in July 2015

Other Heavy Vehicle Regulatory Activity

- Speed Limiters
- Truck Tires
- Motorcoach

Overview of the Safety Challenge

- Annual Average crashes involving heavy vehicles….about 350,000
- 1/3 are single vehicle crashes; 2/3 involve multiple vehicles

Single Vehicle Crashes (32% of HT Crashes)		
Vehicle Failure	4,828	**4%**
Control Loss	21,315	**17%**
Road Departure	68,293	**55%**
Road Departure/Backing	7,517	**6%**
Pedestrian/Cyclist/Animal	8,683	**7%**
Rollover/Non-Collision	12,812	**10%**
Total	**123,448**	**100%**

Multi-Vehicle Crashes (68% of HT Crashes)		
Rear-End	69,349	**26%**
Changing Lanes/Drifting	70,704	**27%**
Tunring/Same Direction	27,922	**11%**
Turn @ Intersection (lateral Direction)	7,353	**3%**
Left Turn Across Path / Opposite Direction	10,686	**4%**
Straight Crossing Paths @ Intersection	33,296	**13%**
Opposite Direction	14,329	**5%**
Backing Into Vehicle	18,367	**7%**
Parking/Same Direction	3,244	**1%**
Other	7,287	**3%**
Total	**262,538**	**100%**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