

Five Lessons for Sustainable Transportation

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UCDAVIS UNIVERSITY OF CALIFORNIA

ITS INSTITUTE OF TRANSPORTATION STUDIES

ITS
UCDAVIS

Thank You to Asahi Glass Foundation



“....supporting advanced research ... and recognizing efforts to solve environmental issues that call for global solutions”

Thank You to ITS-Davis

- Founded: 1991
- 50 (brilliant and passionate) Professors and Researchers
- 130 (brilliant and passionate) Graduate Students
- Recently designated “National Center of Sustainable Transportation” by US Department of Transportation
- Centers within ITS-Davis:
 - Plug-in & Hybrid Vehicle Center
 - Energy Efficiency Center (1st in US)
 - Urban Land Use and Transportation Research Center
 - China Center on Energy and Transportation
 - Sustainable Transportation Energy Pathways Program

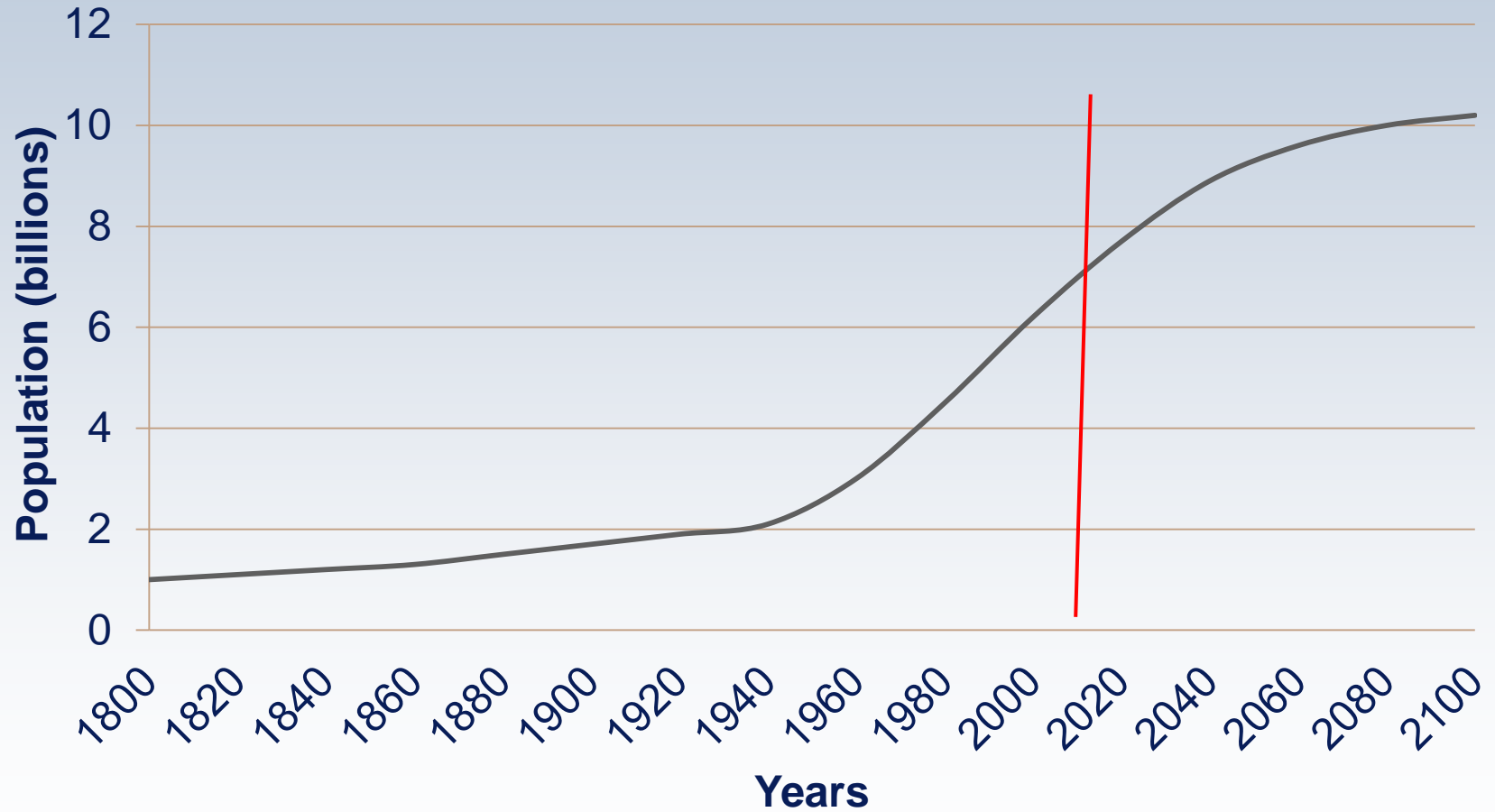
ITS-Davis Team of Faculty, Staff, and Students



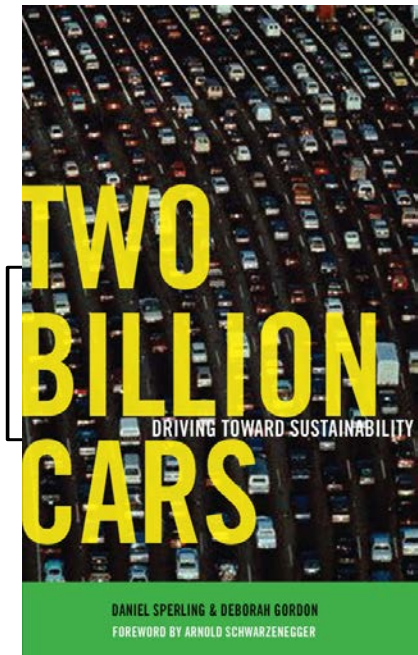
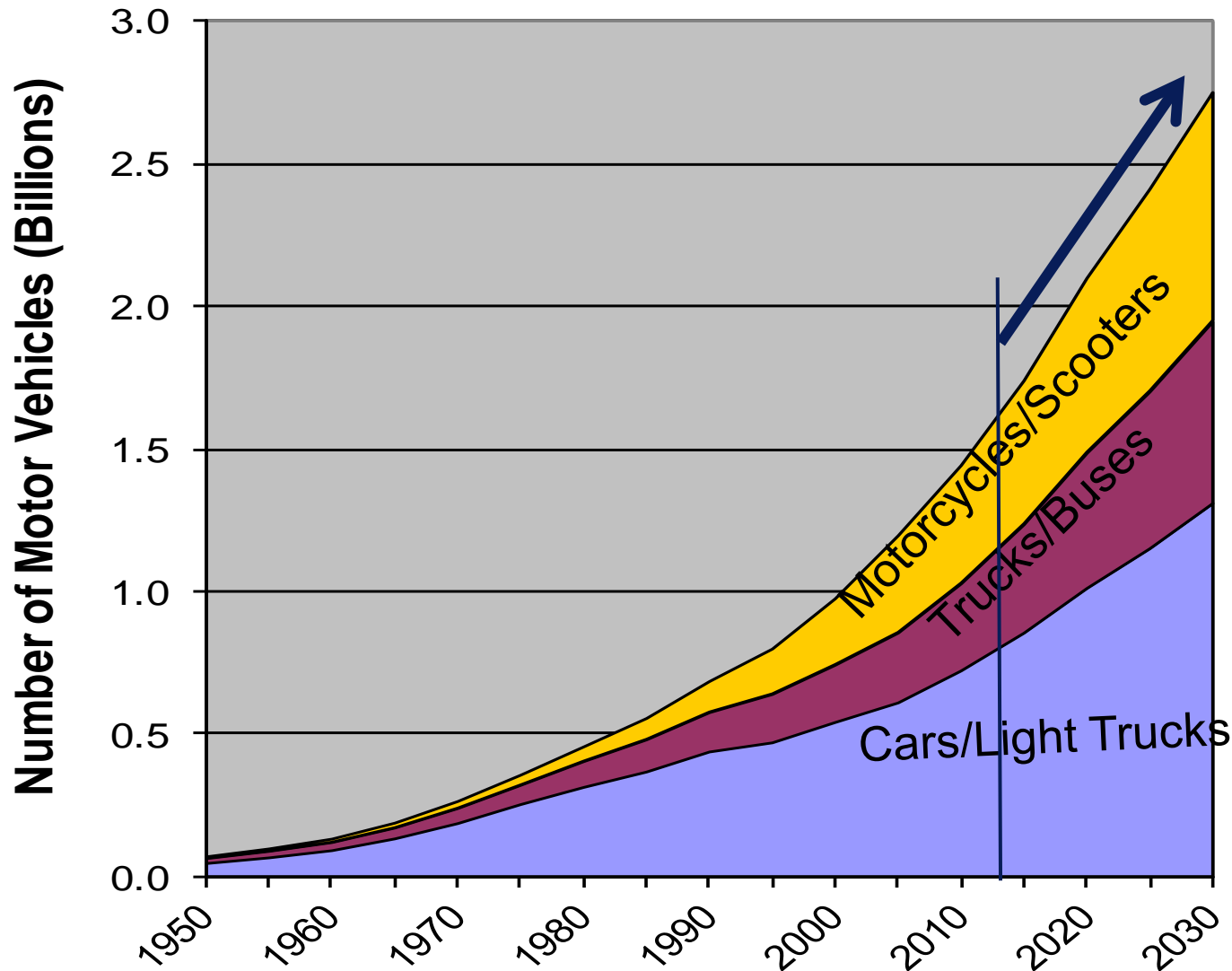
Thank You to California Air Resources Board

- World leaders in air quality and climate policy
- Pioneered Zero Emission Vehicle mandate, Low Carbon Fuel Standards, low emission vehicles, and much more
- Superb staff: technically sophisticated, engaged with stakeholders, passionate
- Visionary leadership with Mary Nichols and Richard Corey, with strong support from Governor Jerry Brown

World Population Is Expected to Increase by 3 Billion



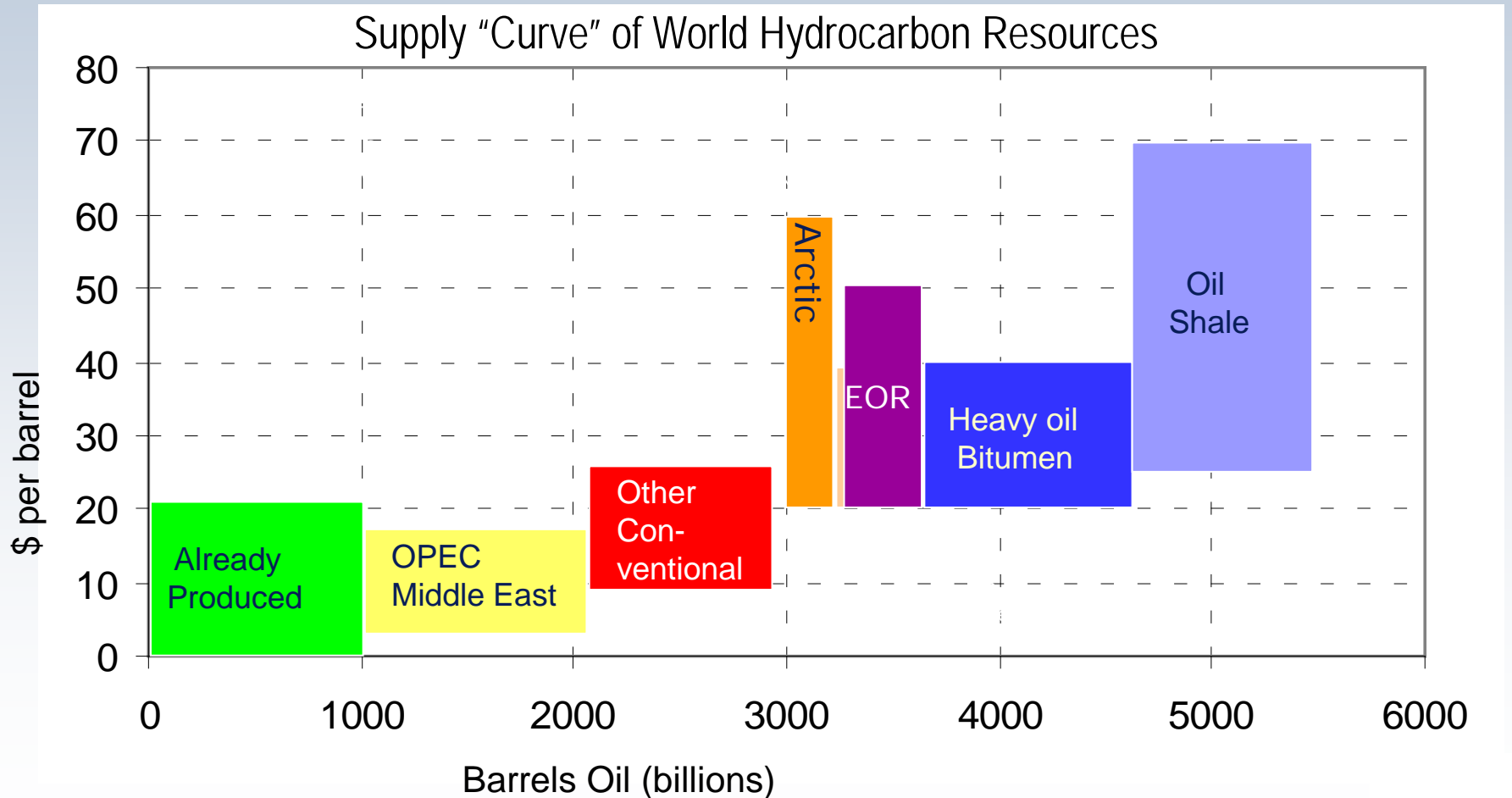
More People + More Wealth = Many More Vehicles



Sperling and Gordon
(2009), based on
DOE, JAMA, other

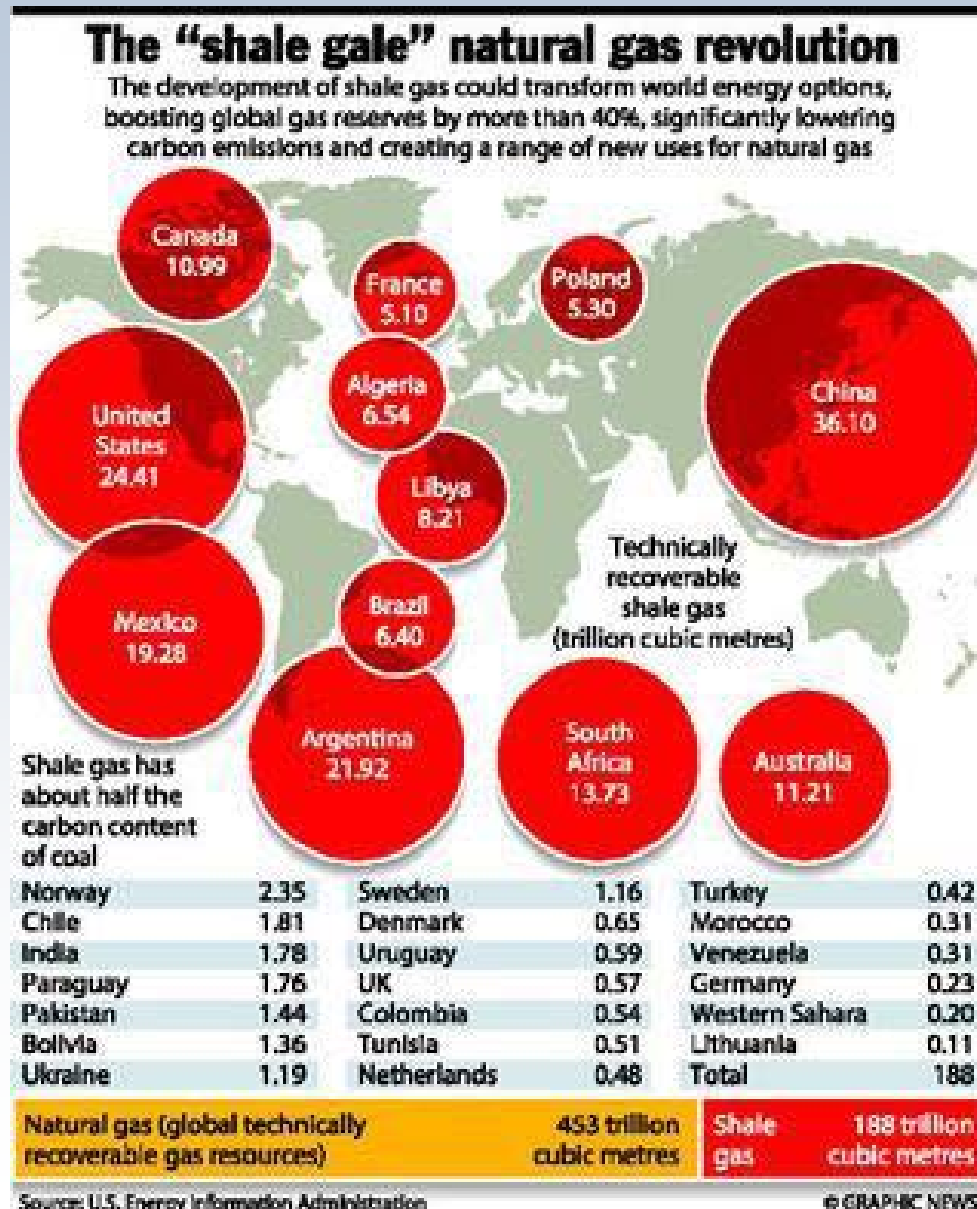
Problem Is NOT Lack of Oil!

Real Problem is Environmental Impact of High-Carbon Unconventional Oil



Energy Revolution Underway ...

More (Unconventional) Oil and Gas Available Globally

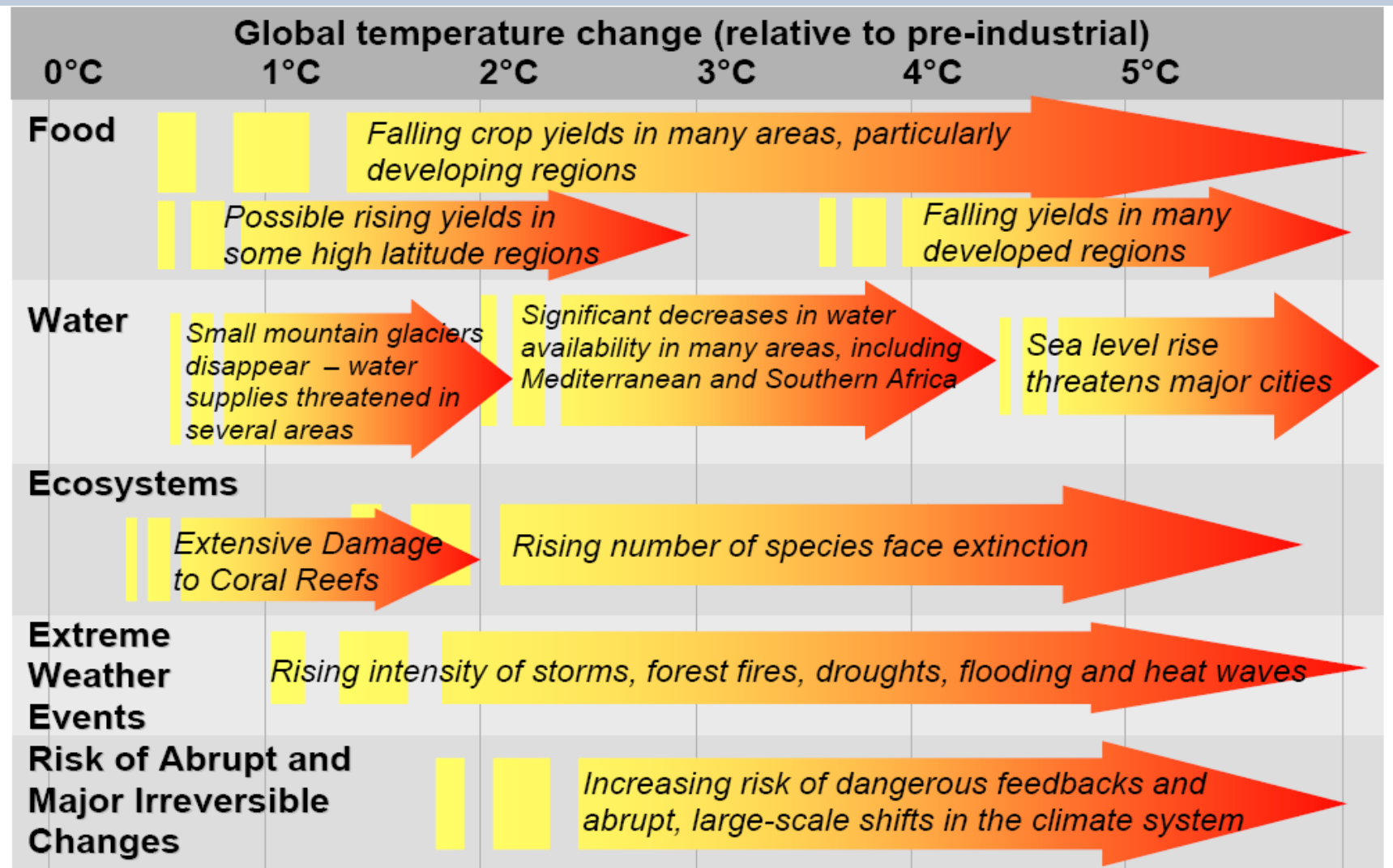


Oil is Being *Re-Carbonized* ... Heavy Oil, Oil Sands, Coal-to-Liquids



Photo of Canadian Oil Sands

Climate Change Is Arguably Greatest Threat



APRIL 3, 2006

www.time.com AOL Keyword: TIME

SPECIAL REPORT GLOBAL WARMING

TIME

**BE
WORRIED.
BE **VERY**
WORRIED.**

Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well

EARTH AT THE TIPPING POINT

HOW IT THREATENS YOUR HEALTH

**HOW CHINA & INDIA CAN HELP
SAVE THE WORLD—OR DESTROY IT**

THE CLIMATE CRUSADERS



2006!

We Will Use Up Our Global Carbon Budget in 30-50 Years—and Then Zero (at current rates)

Carbon Released Since Industrial Revolution

530 billion tons

How Much More Can Be Released?

300 to 500 billion tons

Remaining Fossil Energy (Carbon) Reserves

2800+ billion tons

(800 billion tons emitted from burning known recoverable reserves with today's energy prices and technology)

Transportation Plays Large Role

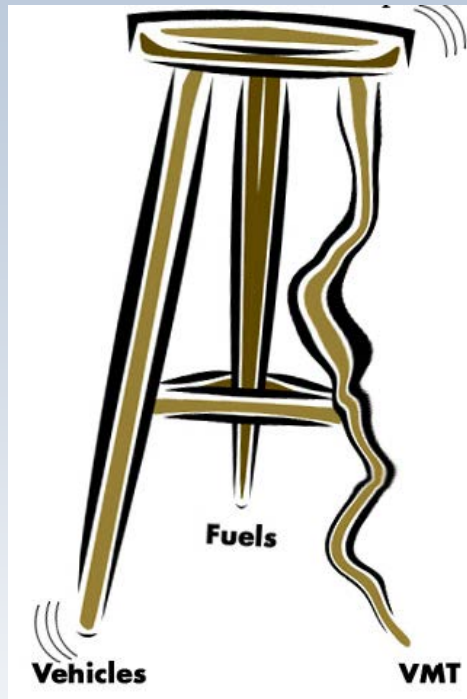


Transportation accounts for 1/4 of global CO₂ emissions and 1/2 of oil in world.

Five Lessons and Conclusions

1. No single solution: Need to pursue many solutions
2. Focus on next steps (desirable pathways), not simplistic end-state visions
3. One size does not fit all.
4. Scientific community needs to engage in near-term decision-making—locally, nationally, globally
5. ???

Transforming Transportation



- Transforming mobility (*hardest*)
- Transforming fuels
- Transforming vehicles (*easiest*)

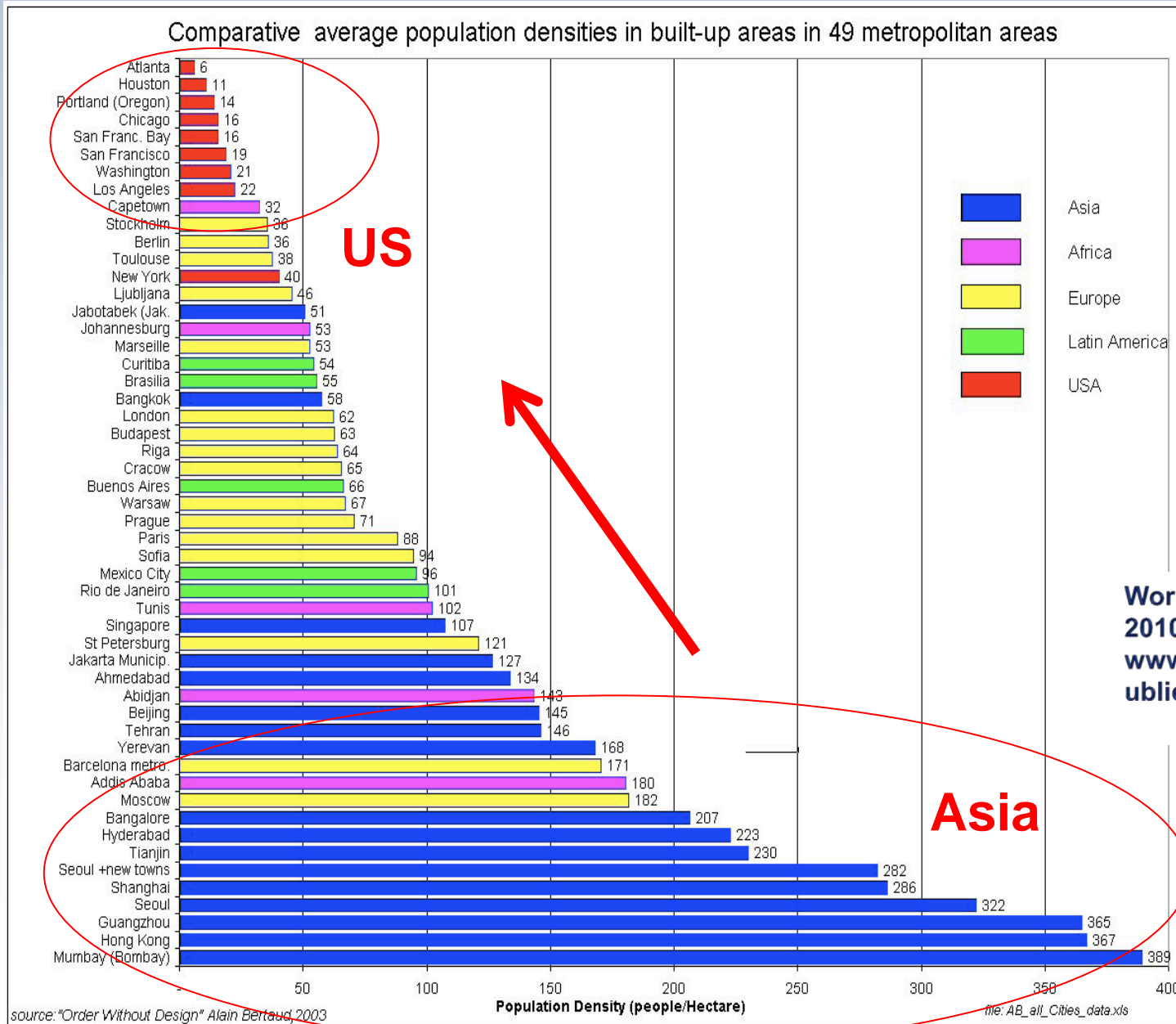
First Leg: Transforming Mobility and Land Use

Starting in California, car-centric cities and lifestyles increasingly dominate cities around the world.

Public transport <20% of passenger kilometers traveled in all rich countries and shrinking almost everywhere.

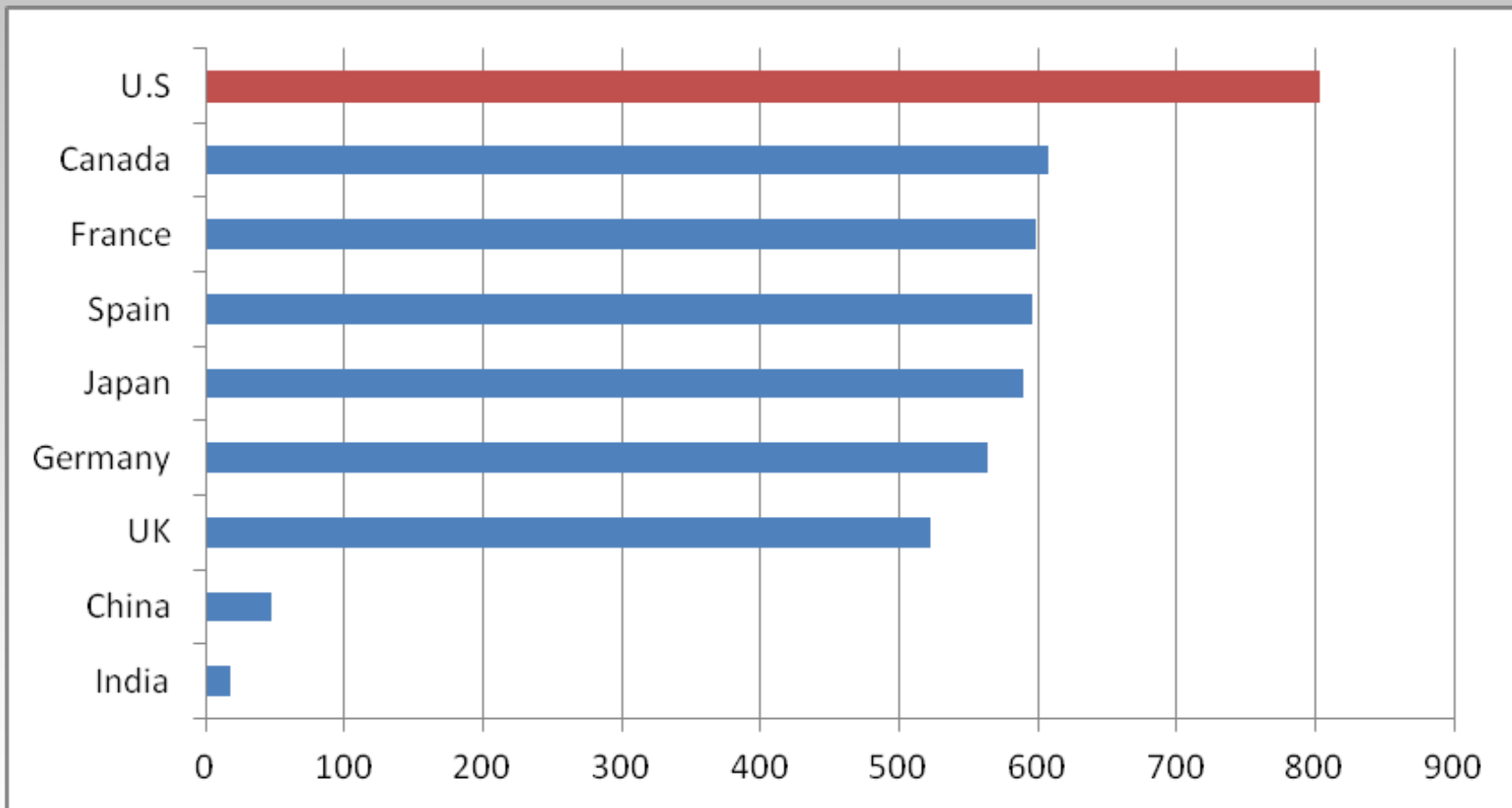


Population Densities: Lowest in US, Highest in Asia



World Energy Council,
2010.
www.worldenergy.org/publications

Motor vehicles per 1,000 people, 2009

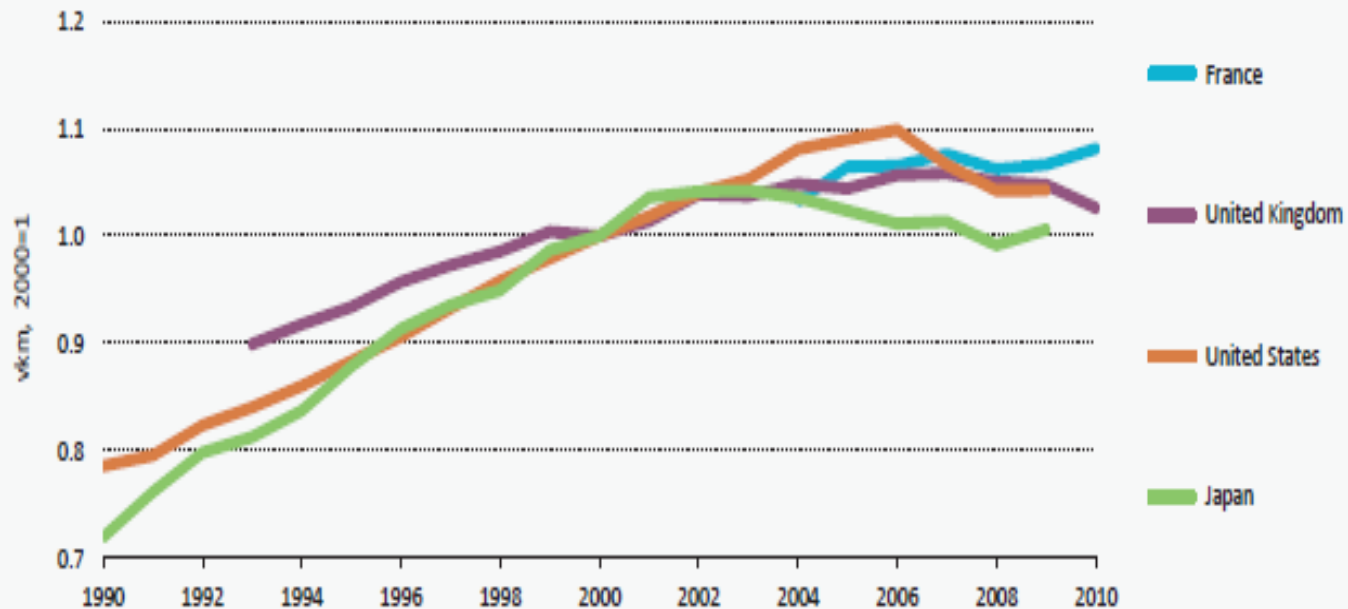


Sources: World Bank 2011. Motor vehicles include cars, buses, and freight vehicles, but do not include two-wheelers.

Travel Peaking in Rich (OECD) Countries

Figure 13.11

Passenger LDV travel for selected OECD countries, indexed to 2000



Key point

Key point: Vehicle travel began to flatten or even decline after 2000, suggesting "peak" travel may be occurring in the OECD.

Source : IEA, 2012 (ETP 2012)

Many Reasons to Reduce Vehicle Use (and Restrain Growth in Emerging Countries)

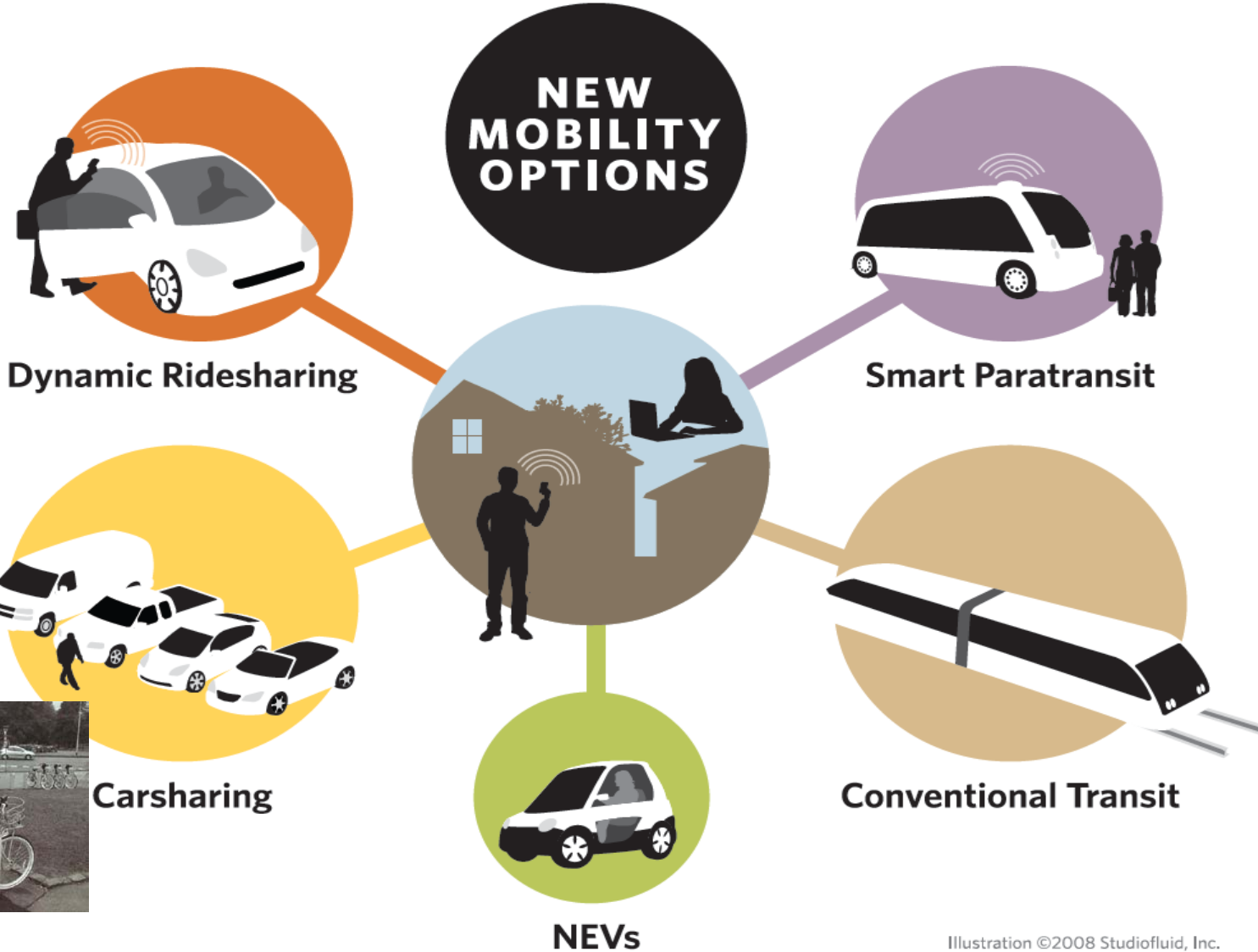
.... for Economy, Environment, and Health

- Reduced road and other infrastructure costs (water, waste water, electricity)
- Reduced air pollution, GHG emissions and oil use
- Greater social equity and “livability” benefits

Not all vehicle trips are “high value”!



Key Strategy: Expand Traveler Choice



Pogo



Second Leg: Transforming Fuels

BIOFUELS

HYDROGEN

ELECTRICITY



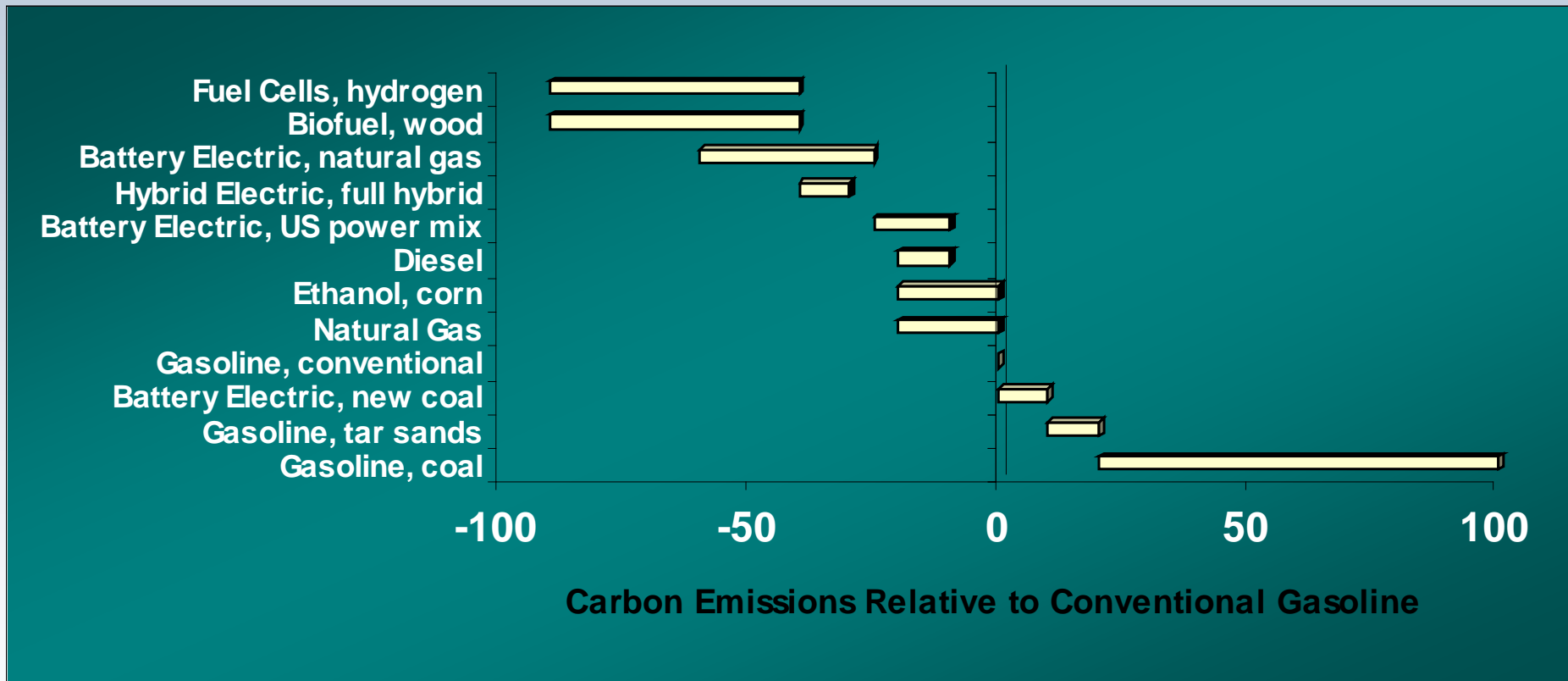
The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil.

Sheikh Zaki Yamani, Saudi Arabian oil minister for 3 decades

- Today: Transport is 96% dependent on oil
- Future: Wide mix of fuels to power mobility
- Big challenges:
 1. How to keep most fossil energy below ground?
 2. How to stimulate innovation and support acceptance of low-carbon alternatives?

Many Promising Replacements

Some better than others...



Fuel *du jour* Phenomenon

Disruptive and wasteful

- **30 years ago – Synfuels (oil shale, coal)**
- **25 years ago – Methanol**
- **20 years ago – Electricity (Battery EVs)**
- **10 years ago – Hydrogen (Fuel cells)**
- **5 years ago – Ethanol**
- **Today – Electricity (Plug-in hybrid vehicles)**
- ***What's next?***

California Leadership on Fuels Policy

- Low Carbon Fuel Standard (adopted 2009)
 - Requires 10% reduction in carbon intensity of transport fuels by 2020
 - Utilizes lifecycle analysis
 - Harnesses market forces (via credit trading)
 - *Similar policy adopted by EU*

Third Leg: Transforming Vehicles

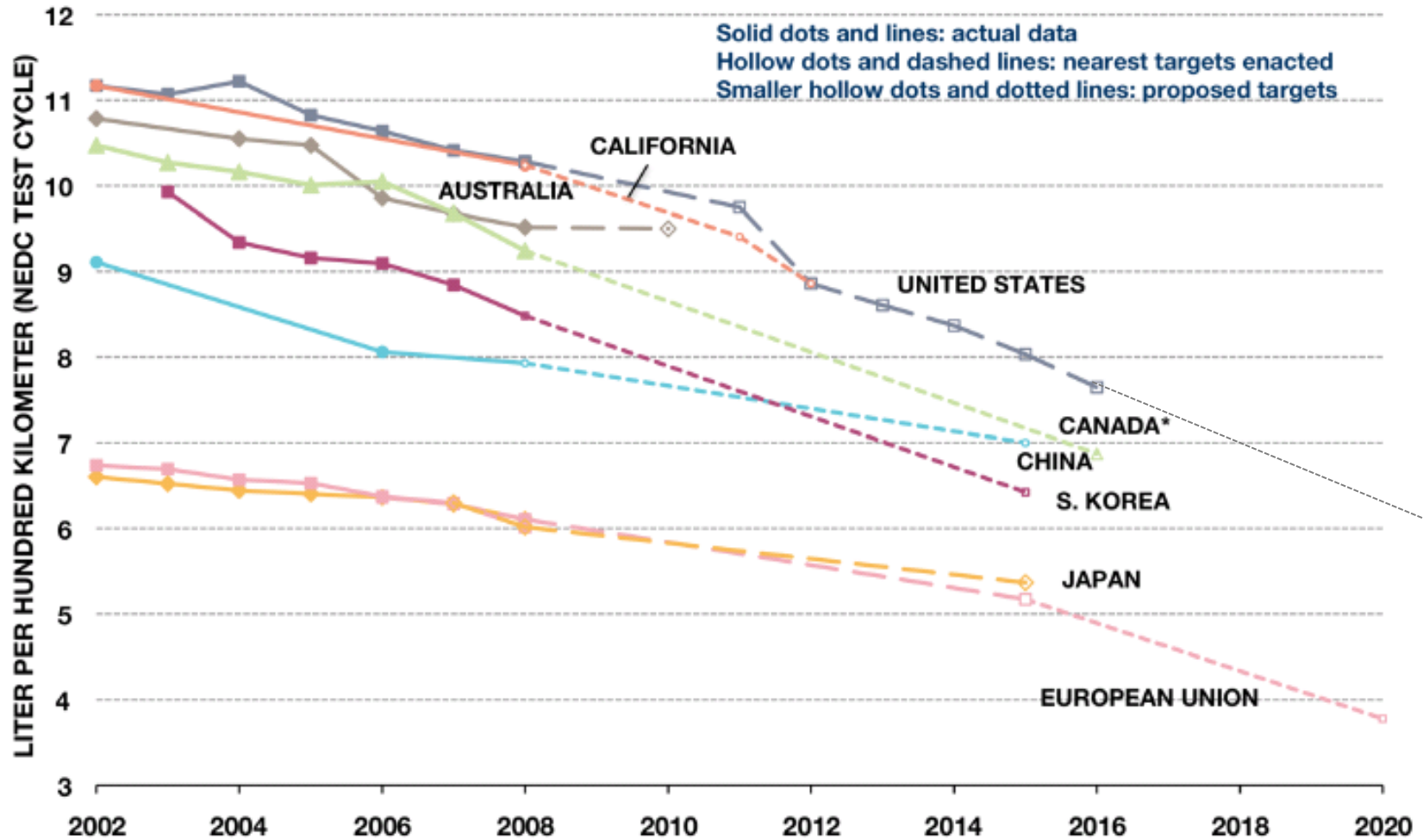
*Cars of future will be far more efficient and
will be powered mostly by electric-drive*

Success story for technology and policy!

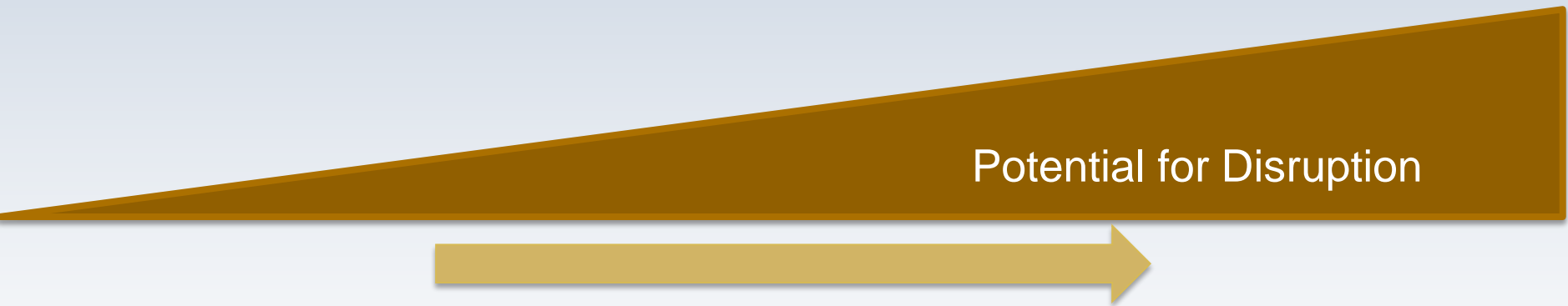
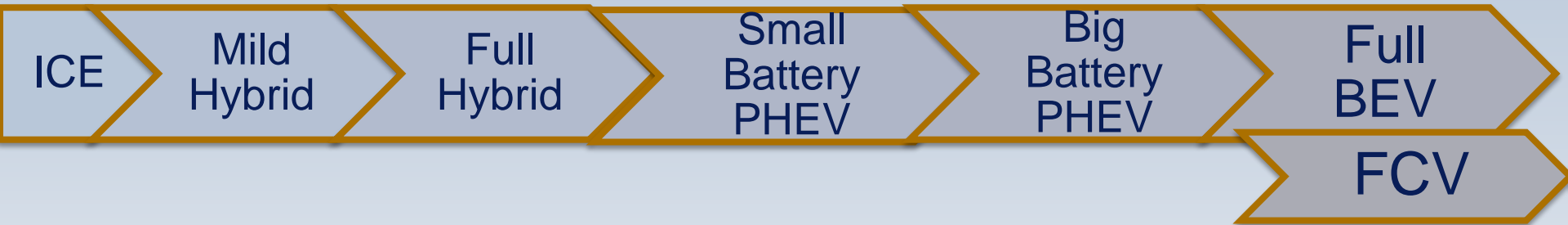


Huge Success Story!

Vehicle Efficiency Improving Worldwide



Moving Forward on Electrification



Disruptive process ... will it continue?

Japan is Global Leader on Vehicle Electrification

- Highest sales of hybrid vehicles (19%)
- Most fast chargers for electric vehicles
- Strongest public-private partnerships with battery electric and fuel cell vehicles (and leading automotive companies)

Truck Efficiency and Technology Are Advancing Also, But More Slowly

Fuel Cell Truck



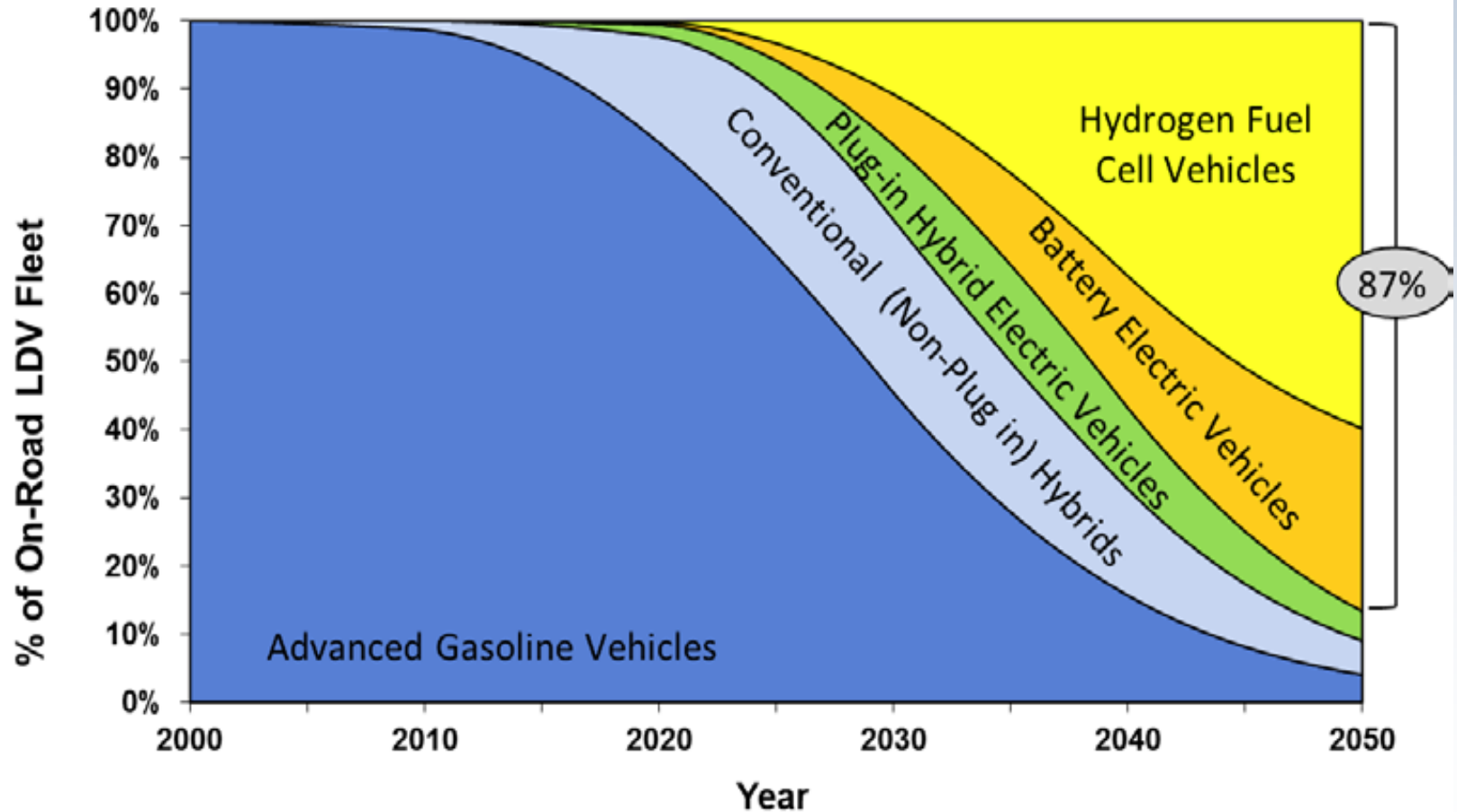
Electric Truck With Overhead Wires



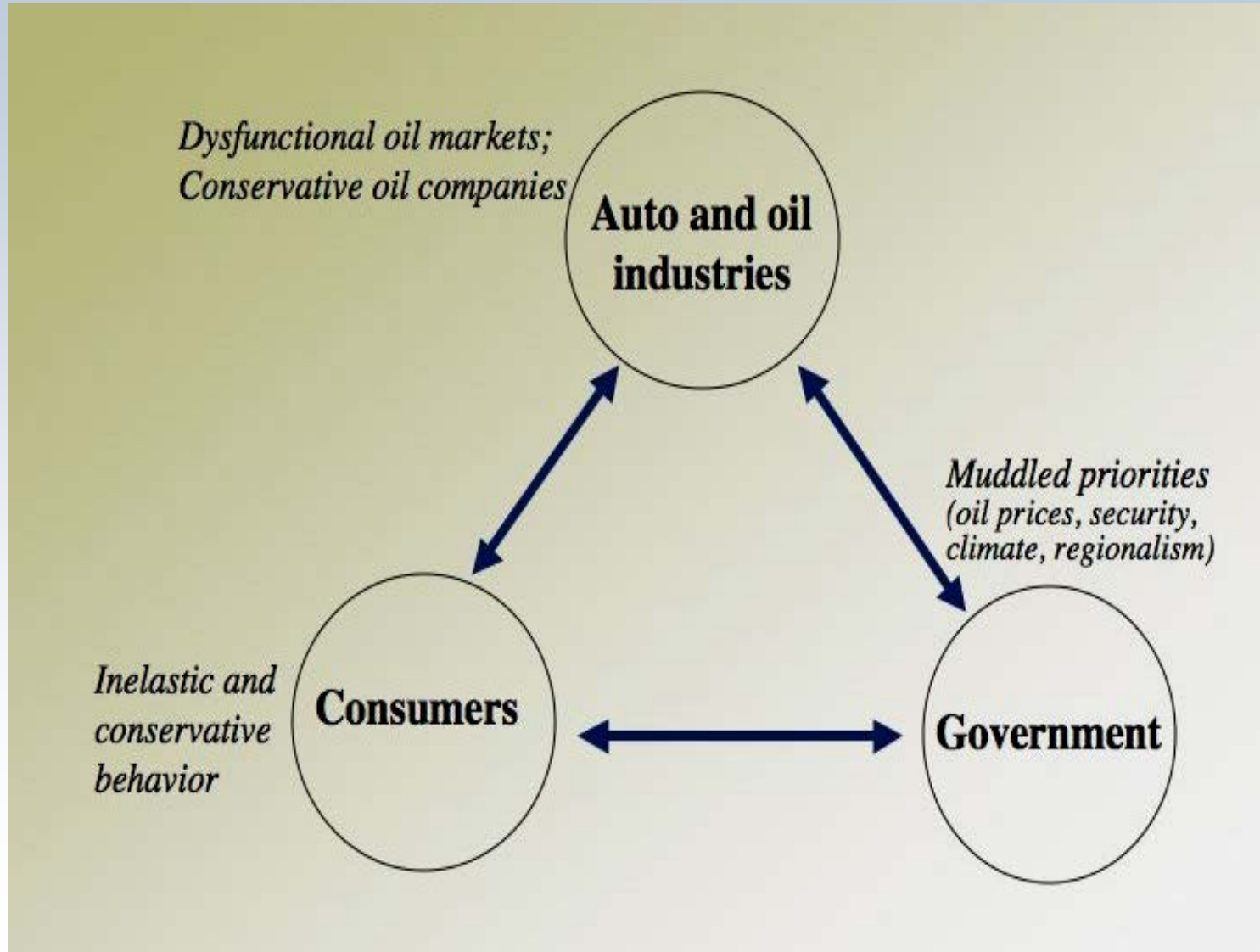
Battery Electric Truck



California (CARB) Plan for Light Duty Vehicles: 87% Plug-in and Fuel Cell Vehicles in 2050



Many Challenges--Clashing Interests and Priorities



Policy Strategies to Transform Transportation

- **Performance standards for fuels/GHGs**
Low carbon fuel standard, tighten vehicle standards
- **Market instruments to align regulations with market**
Fuel and carbon taxes
Feebates
- **Accelerate commercialization of advanced vehicles**
Require and reward electric and fuel cell vehicles
- **Restrain vehicle use**
Improve public transportation, expand mobility choices, increase the cost of driving, manage urban land use
- **Increased R&D investments (and training of next generation of scientists and engineers)**
Biofuels, batteries, fuel cells, lightweight materials, innovative mobility technologies



Five Lessons and Conclusions

1. No single solution: Need to pursue many solutions (which mostly exist already)
2. Focus on change (desirable pathways), not simplistic end-state visions
3. One size does not fit all. Tailor solutions to each situation (fuels, vehicles, mobility, infrastructure)
4. Scientific community needs to engage in near-term decision-making—locally, nationally, globally
5.

5. Take Action Now!



Domo arigatou gozaimasu

有難う 御座います