Policies for Low Carbon Transportation

...as seen by a policy wonk, regulator, and academic

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and
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Pace Energy and Climate Center
New York

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Good news and bad news

Soaring Global Demand for Vehicles (and Oil)

Sperling and Gordon (2009), based on DOE, JAMA, other
More VMT + Carbonization of Fuels = Large INCREASES in Carbon

![Supply “Curve” of World Hydrocarbon Resources](image)

- Already Produced
- OPEC Middle East
- Other Conventional
- Arctic
- EOR
- Heavy oil Bitumen
- Oil Shale

IEA, 2005
SPECIAL REPORT GLOBAL WARMING

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
(Even) Oil Ministers of Saudi Arabia Say...

1) “Greenhouse gas emissions and global warming are among humanity’s most pressing concerns. Societal expectations on climate change are real, and our industry is expected to take a leadership role.” (Ali I. Al-Naimi, Jan 2012)

2) 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 2+ decades
What does this mean for transportation?
Transforming Transportation

- Transforming vehicles
- Transforming fuels
- Transforming mobility
Why government initiative is needed

A Long List of Market “Failures”

• Environmental and energy externalities
• Principal agent problem (rental cars, truck trailers, company cars)
• Network externality. Complementary products requiring large non-recoverable investments and investments that cannot be made by individual consumers—such as when different vehicles or different infrastructures are required (H2, bike paths for biking, smart paratransit, etc)
• Technology lock-in
• Market power (cartels, oligopolies, etc)
• High entry barriers in auto industry
• R&D under-investment due to:
  ▪ industry diffusion (ag industry)
  ▪ R&D spillovers. When R&D findings cannot be fully captured (leading to under-investment in R&D)
  ▪ Learning-by-doing spillovers where mfg savings not fully captured
• Consumer cognition (eg, buying cars), resulting in under-investment in efficiency (related to information and loss-aversion)
• Volatile oil prices create uncertainty which leads to under-investment in alternatives
1st Leg

The Motor Vehicle Revolution

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

1) Vehicle efficiency improvements are far easier and less expensive than previously thought….
   Lightweight materials, transmissions, engines, hybridization

2) New evidence suggests that batteries and fuel cells will be far less expensive than previously thought

3) Trucks and planes are bigger challenges
   Modest increases in energy efficiency and shift to biofuels are likely
Horsepower Race is Over!

Toyota RAV4, 2008

Ferrari 308 GTS, 1984

7.3 seconds from 0-60 mph

7.3 seconds from 0-60 mph

Tom Selleck as Magnum, PI
Automakers + Policy = Big Success Story
CEOs Support Aggressive 2025 Vehicle GHG Standards

Government-industry agreement (July 29, 2011)
Obama administration, automakers, and California agree to national US standards
Vehicle Efficiency Improving Everywhere (doubling in US from 2010 to 2025)

[1] China’s target reflects gasoline fleet scenario. If including other fuel types, the target will be lower.
2025 CAFE/GHG 54 mpg Standards Probably Won’t Stimulate Significant PEV Sales by 2025…

Even With Special ZEV Credits (EVs count as 0 g/mi and receive 2x credits initially)

<table>
<thead>
<tr>
<th>Stringency</th>
<th>% GHG reduction/yr</th>
<th>% Hybrids</th>
<th>% EVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4%</td>
<td>18</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>43</td>
<td>1</td>
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</tbody>
</table>

CARB/EPA/DOT Analysis of Technology Needed for Compliance
What We Know…
Continuum of Electrification, But Uncertain Market Outcomes

ICE → Mild Hybrid → Full Hybrid → Short AER PHEV → Long AER PHEV → Full BEV → FCV
PEVs and FCVs Poised for Commercial Success—Finally!

Old Generation EVs/FCVs

1st FCV
GM EV1

New Generation PEVs/FCVs (w/strong industry support)

Volt
Leaf
E-scooter

FCV

Neighborhood EV
PEVs Almost Competitive?!
2nd Leg

Transforming Fuels

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 2+ decades

• Today: Transport is 94% dependent on oil
• Future: Diversity of Fuels
To Stabilize at 450 ppm (+2°C) in 2050...

75% of energy for LDVs & urban trucks (globally) is biofuels, H2, electricity

IEA, 2012, provided by Lew Fulton
ZEV Mandate (California +10 states) is Key Policy for Electricity (and H2)

- **FCVs**: 14% of 2025 New Vehicle Sales
- **BEVs**: 12% of 2025 New Vehicle Sales
- **PHEVs**: 9% of 2025 New Vehicle Sales
Fuel *du jour* Phenomenon
Disruptive and wasteful

- 30 years ago – Synfuels (oil shale, coal)
- 25 years ago – Methanol and CNG
- 20 years ago – Electricity (Battery EVs)
- 10 years ago – Hydrogen (Fuel cells)
- 5 years ago – Ethanol
- Today – Electricity (again)
- *What’s next?*

GOVERNMENT POOR AT PICKING WINNERS …
NEED DURABLE POLICY (such as low carbon fuel standard)
Many Promising Replacements

Some better than others...

| Fuel Cells, hydrogen | Biofuel, wood | Battery Electric, natural gas | Hybrid Electric, full hybrid | Battery Electric, US power mix | Diesel | Ethanol, corn | Natural Gas | Gasoline, conventional | Battery Electric, new coal | Gasoline, tar sands | Gasoline, coal |

Carbon Emissions Relative to Conventional Gasoline
Canada Plans Significant Growth in Oil Sands

All energy alternatives are difficult and face major barriers

- Biofuels
- Hydrogen and FCVs
- EVs
- CNG

And thus need flexible, performance-based, technology-forcing policy
US Requirements for Biofuels (RFS, 2007)
Uncertain Prospects for Advanced Biofuels?

US forecasts based on “existing” capacity

<table>
<thead>
<tr>
<th>Advanced Biofuel Capacity</th>
<th>2012 Capacity</th>
<th>2015 Capacity</th>
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<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Jet Fuel</td>
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<tr>
<td>Biodiesel</td>
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<td>Butanol</td>
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<td>Adv. Diesel</td>
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<td>7</td>
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<tr>
<td>Fuel flexible</td>
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<tr>
<td>Biocrude</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>129</td>
<td>165</td>
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</table>

“Fuel flexible” may produce advanced gasoline or diesel.

California Low Carbon Fuel Standard (LCFS)  
(Adopted April 2009, took effect 2011) (also being adopted EU, Oregon)

Policy Design
- 10% reduction in carbon intensity of transport fuels by 2020
- Oil refiners are point of regulation
- Allows credit trading (harness market forces)

Why Important and Good Policy?
- Doesn’t pick winners: includes all fuels (unlike national RFS)
- Harnesses market forces (via tradable credit market)
- Stimulates innovation and investment
- Performance based
- Relies on lifecycle analysis (scientifically based)
3 Policy Options for US

• RFS + other regulations and subsidies
  ▪ Mandates for EVs, FCVs, etc
  ▪ Subsidies for electricity, H2, and biofuel infrastructure

• Replace RFS With LCFS

Enhanced RFS (with features of LCFS)
  ▪ Include other transport fuels
  ▪ Create performance metric to incentivize innovation
  ▪ Add “price cap” for tradable credits (“flexible compliance mechanism”)
3rd Leg

Transforming Mobility (and Land Use)

In U.S. and increasingly elsewhere, we’ve created a transportation monoculture, with shrinking choices and increasing sprawl.

Many ways to provide equal accessibility at less cost—with less energy and GHG emissions.
Not all vehicle trips are “high value”!
Key Strategy: Innovation to Expand Traveler Choice

- Dynamic Ridesharing
- Smart Paratransit
- Carsharing
- Conventional Transit
- NEVs
One Policy Model to Reduce VMT and Sprawl

California Sustainable Communities Act (SB375)

- Imposes targets on cities/MPOs to reduce sprawl and VMT via compact development, improved transit, and pricing
  - GHG targets imposed on major cities (sept 2010):
    - 2020: 7-8% reduction/capita (mostly via reduced VMT)
    - 2035: 13-16% reduction/capita (mostly via reduced VMT)

- But weak incentives (need to find way to financially reward cities)

- Why good policy?
  - Provides performance-based mechanism for funding cities
  - Defers to local governments
  - Empowers local governments to do good planning and investment
    - Policies to reduce VMT and GHGs are aligned with good planning practices (generate large co-benefits: reduced infrastructure costs, healthy communities)
Vehicle Transformation Is Fastest and Easiest in Near Term, But Fuels is Most Critical in Long Term

- Most Feasibility
- Least Feasibility

- Vehicle technology: efficiency, electric-drive
- Decarbonize fuels: biofuels, electricity, hydrogen
- Mobility and land use

Quantity Reduced (oil, GHGs)
"We stand at a crossroads. One path leads to despair, the other to destruction. Let's hope we choose wisely."
Woody Allen

Headed into a painful century… but humans are incredibly creative. Eventually we will rise to the challenge … hopefully soon!

Thank You