California’s electrification of transportation in a changing vehicle and mobility landscape

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Three things on the transformation of transportation

Electrons and molecules

It’s been a looooong haul, but we are finally there

Preparing for revolution and evolution
The Three Regulatory Pillars of Environmental Protection in California

Federal (EPA)

State (ARB)

Regional Air Districts
Electrons and molecules - the “no compromise” and “cheat-proof” alternative to petroleum combustion

State targets:
1.5m ZEV by 2025 (existing regulations)
5m ZEV by 2030 (regs in progress)
Barriers to electrification

- Vehicle costs still high $
- Policy requirements are modest
- Consumer awareness and education about ZEVs is low
- Infrastructure, infrastructure, infrastructure
- Marketing and selling ZEVs
  - “But apathetic dealers and salespeople with little knowledge remain one of the biggest obstacles to widespread electric car adoption.”

Stephen Edelstein from Greencar reports Oct 5, 2016 on Christian Science Monitor
ZEV Models On-Road Today and Coming Soon

Increased Diversity:
- Longer range BEVs
- AWD Models
- SUVs
- Minivan

Source: IHS Automotive Registrations and assorted trade press reports
EV LITHIUM-ION BATTERY PACK PRICE
($/KWh)

EV lithium-ion battery pack prices will have fallen 77% between 2010 and 2018

EV cost parity crossover with IC cars on capital cost alone

Observed values,
BNEF EV Lithium-Ion battery price index

Reported future value,
major manufacturers

Projected price, based on
14-19% experience curve

Source: Bloomberg New Energy Finance. EV lithium-ion battery price index

Note: Forecast range based on a learning rate of 14-20%. EV cost parity is calculated on an unsubsidised total cost of ownership (TCO) basis.
Data range reflects those over with different vehicle classes in the US.
ZEV Charging and Fueling Infrastructure Today and in 2025

• Current Programs:
  • Today: Over 15,000 public EV chargers
  • Today: 31 retail-open hydrogen stations
  • By 2025, expect 104,000 EV chargers and 100 hydrogen stations

• What we need to support 1.5 million ZEVs + PHEVs on the road:
  • 250,000 EV chargers
  • 200 hydrogen stations
Are we witnessing the beginning of the end for ICE?

California lawmaker wants to ban gas car sales after 2040

“sooner or later the country will have to ban diesel cars” Angela Merkel, German Chancellor
Preparing for revolution and evolution

The mega-trends: safe, green, autonomous/connected/shared
Opportunities and Risks with “Autonomous & Sharing” Disruptions

**Opportunities**

- Lower GHG emissions
- Better access to destinations
- Connection to transit
- Faster ZEV cost payback
- Reduced parking needs
- Active transportation (*from changing car ownership attitudes*)

**Risks**

- VMT growth & congestion (*because we are still a car culture*)
- Mode shift from transit
- Limited access to data
- Limited ZEV fueling access
Considerations at State and local level

- Considering ZEV, AV, and CV requirements in new regulations
- EV infrastructure to enable EV autonomous and ride hailing
- EV ride hailing requirements
- Road user charges for ZEVs, AVs
- SB 375 – consider GHG quantification of shared use trips
- Expand pooling of riders
- Discourage empty miles (in AVs, ride hailing)
- Link to transit (e.g. subsidize ride hailing to transit)
- EV only zones (e.g. City of LA concept)
- Congestion mitigation (e.g. priority curb drop off areas)
“In the transportation sector, more change is expected in the next 10 to 20 years in transportation than what has taken place in the last 100 years”