

# Impact of Climate Change – Not Business as Usual

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THE INTERNATIONAL COUNCIL  
ON CLEAN TRANSPORTATION

# Focus of Talk

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- Need to get off petroleum
- Is it feasible?
- Technology pathways for vehicles and fuels
- Transition timing
- Summary

# Drivers to Get Off Petroleum

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- Climate
- Air pollution
- AB32 and likely successor
- Obama Carbon Pollution Standards
- Increasing costs of petroleum

# Consumption of Oil and Gas

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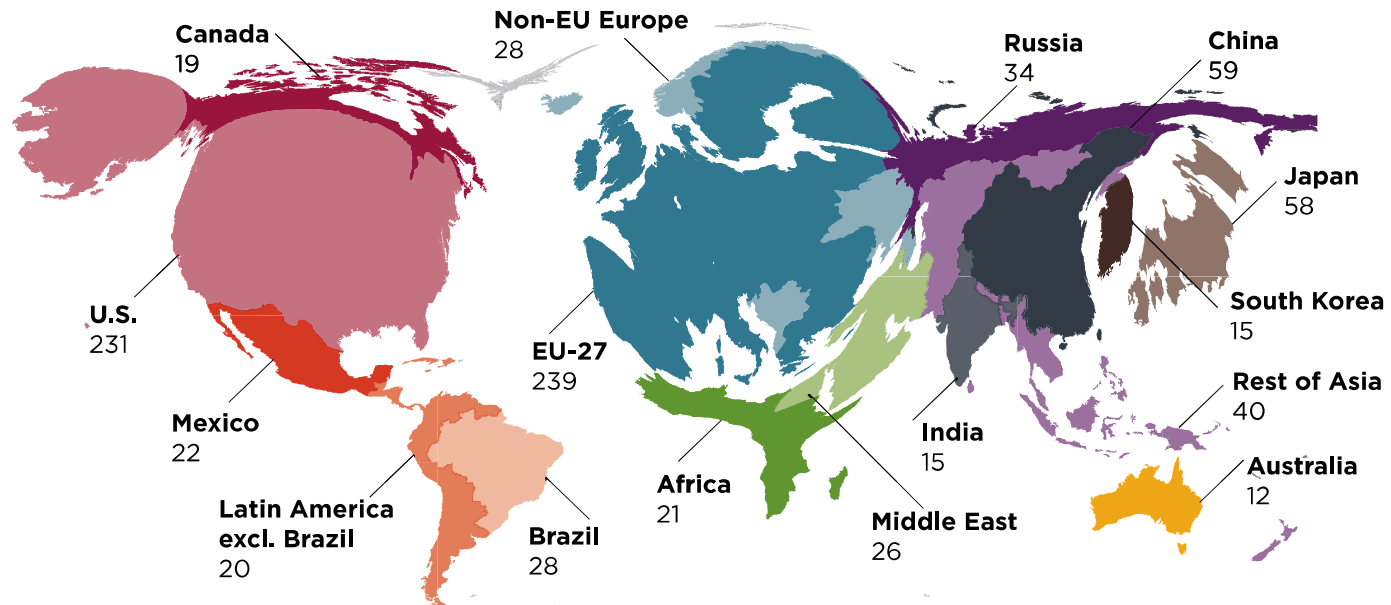
- California is major consumer of oil and gas
- Demand increasing globally as shown on next slides

# Global Car Fleet– Cars & Vans

## Number of cars and vans on the road in 2010

**2010**

Light-duty vehicle stock (in million vehicles)

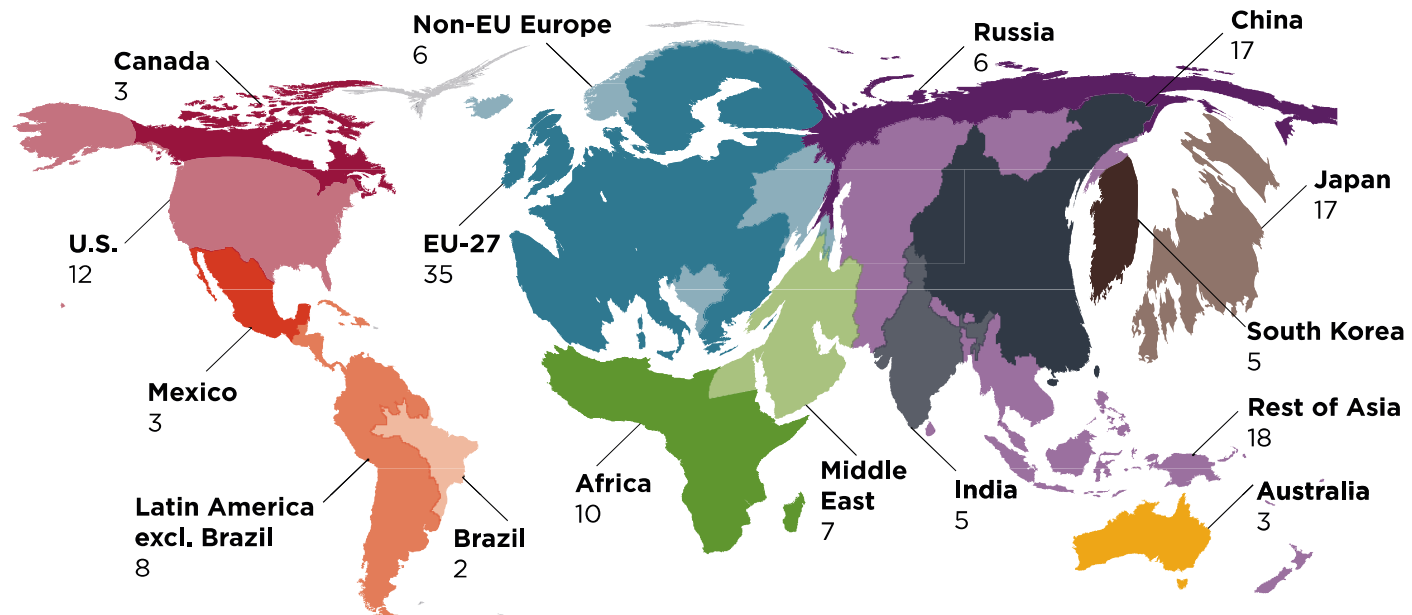


# Global Car Fleet– HDVs

## Number of HDVs on the road in 2010

**2010**

Heavy-duty vehicle stock (in million vehicles)

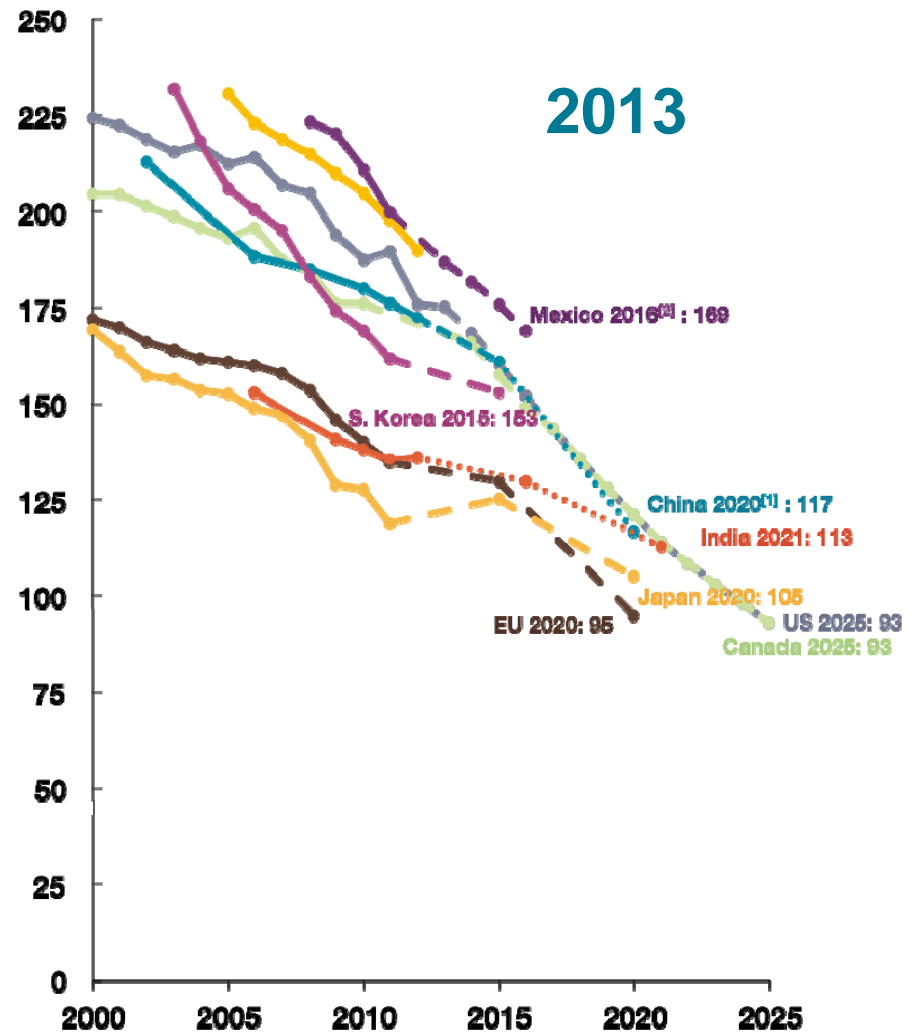
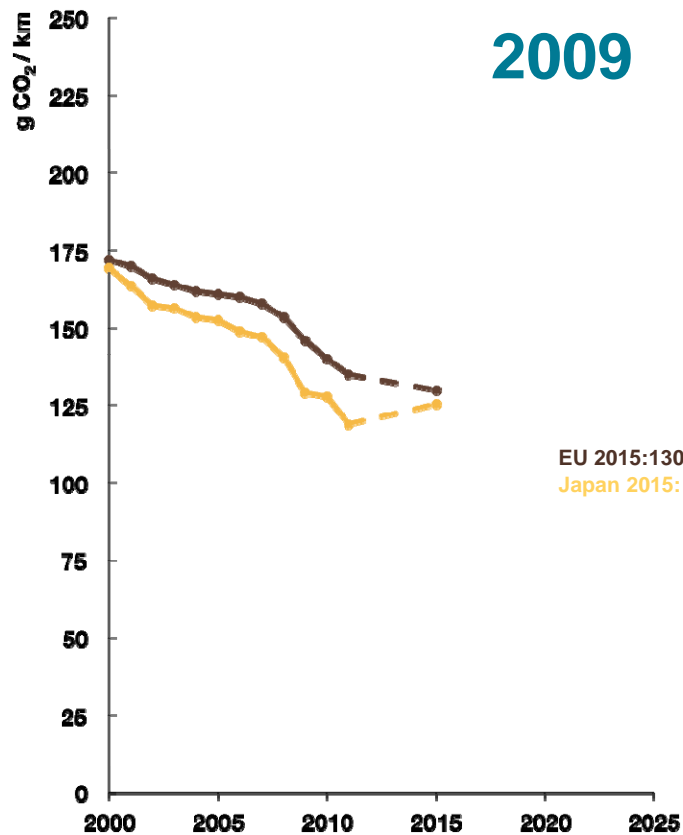


# Fuel Economy Standards Offset by Growth in Developing World

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- Fuel economy standards are impacting consumption— together with lower car ownership (e.g. Europe)
- However, developing world still showing strong growth

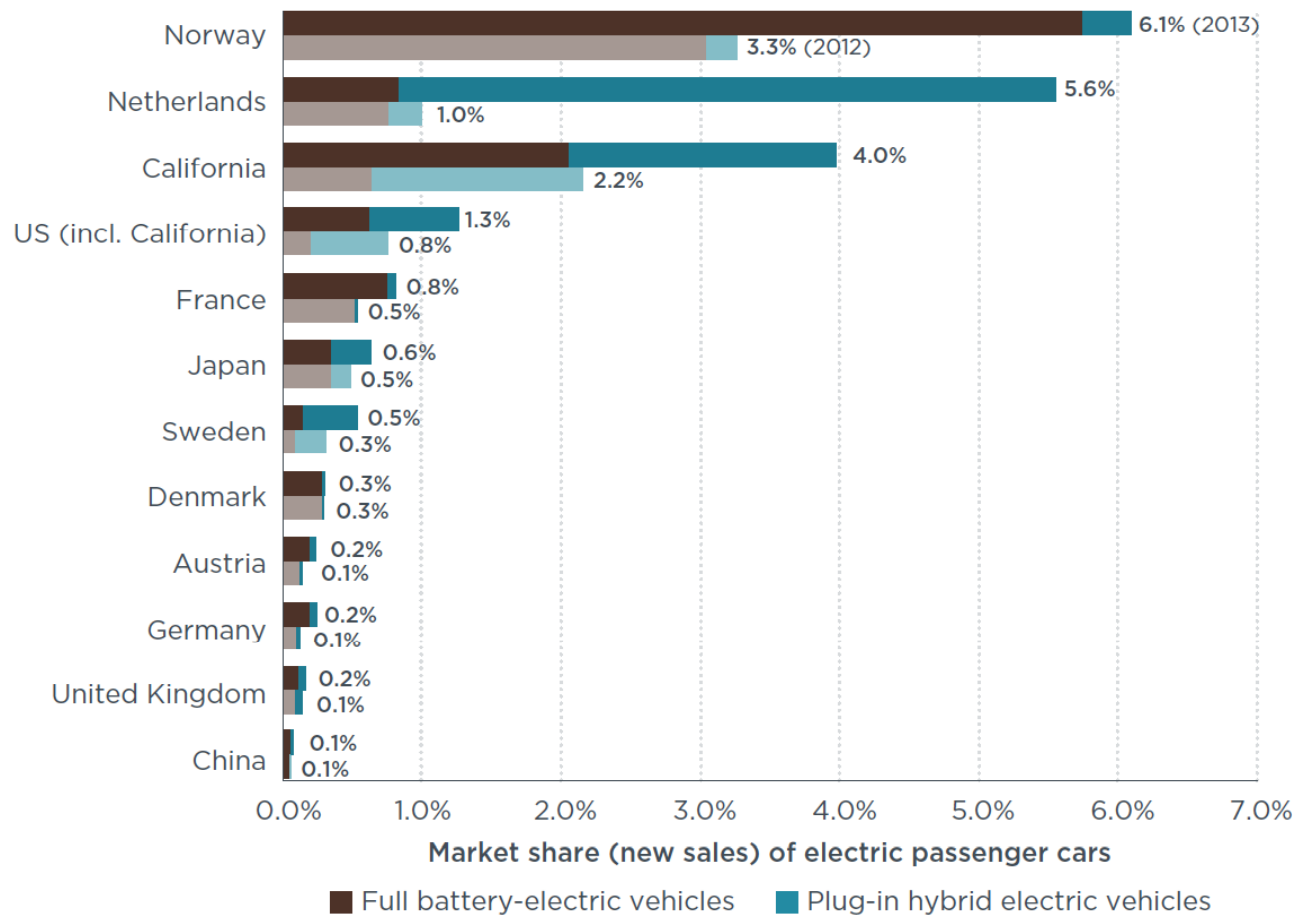
## Cars CO<sub>2</sub> regulation in the world's key markets in 2009 and 2013





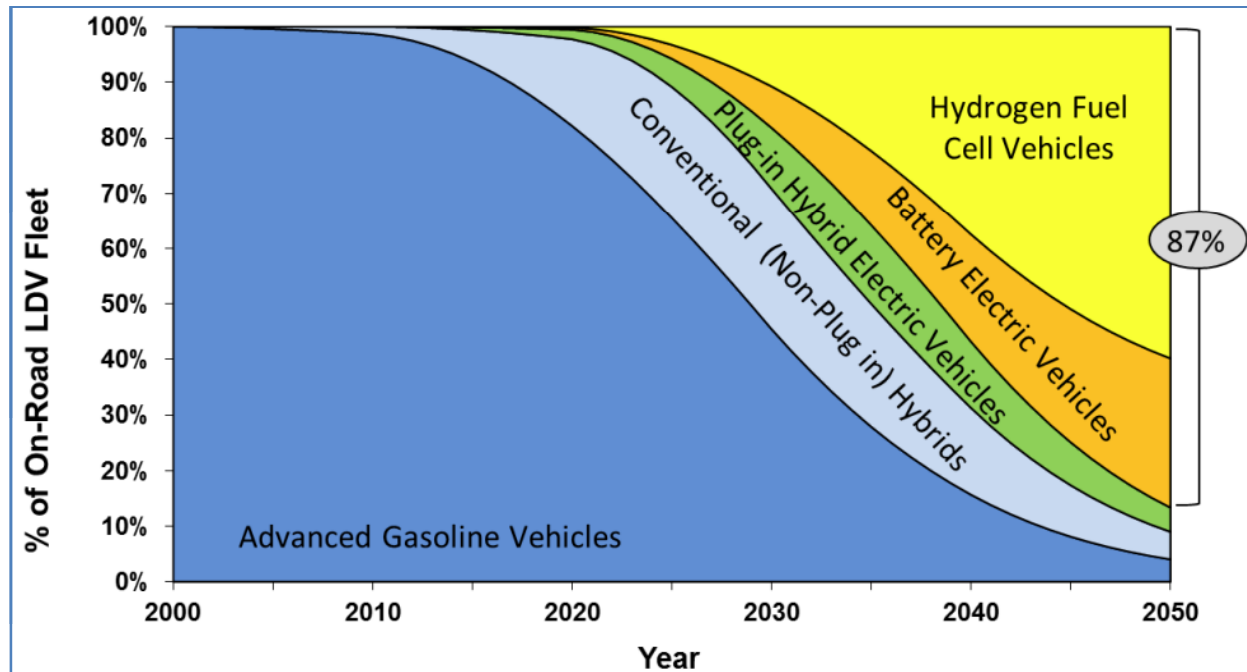
# Some countries are quickly transitioning to low-carbon vehicles...

## Market share of electric cars in comparison to total sales in 2012/13



# Electric Drive Penetration by 2050

LDV On-Road (all vehicles)



# Scale and Duration of Needed Investment

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- Net costs are incurred for about a decade
- Incentives are initially large but are generally unnecessary after 2025
- Caveats
  - Incentives need to be timed properly—not effective if technology is not ready
  - Estimates provided are for total cost, but no need for entire incremental cost to be financed or subsidized; manufacturers will absorb some portion for marketing purposes

# Deployment Estimates for FCV, BEV, PHEV

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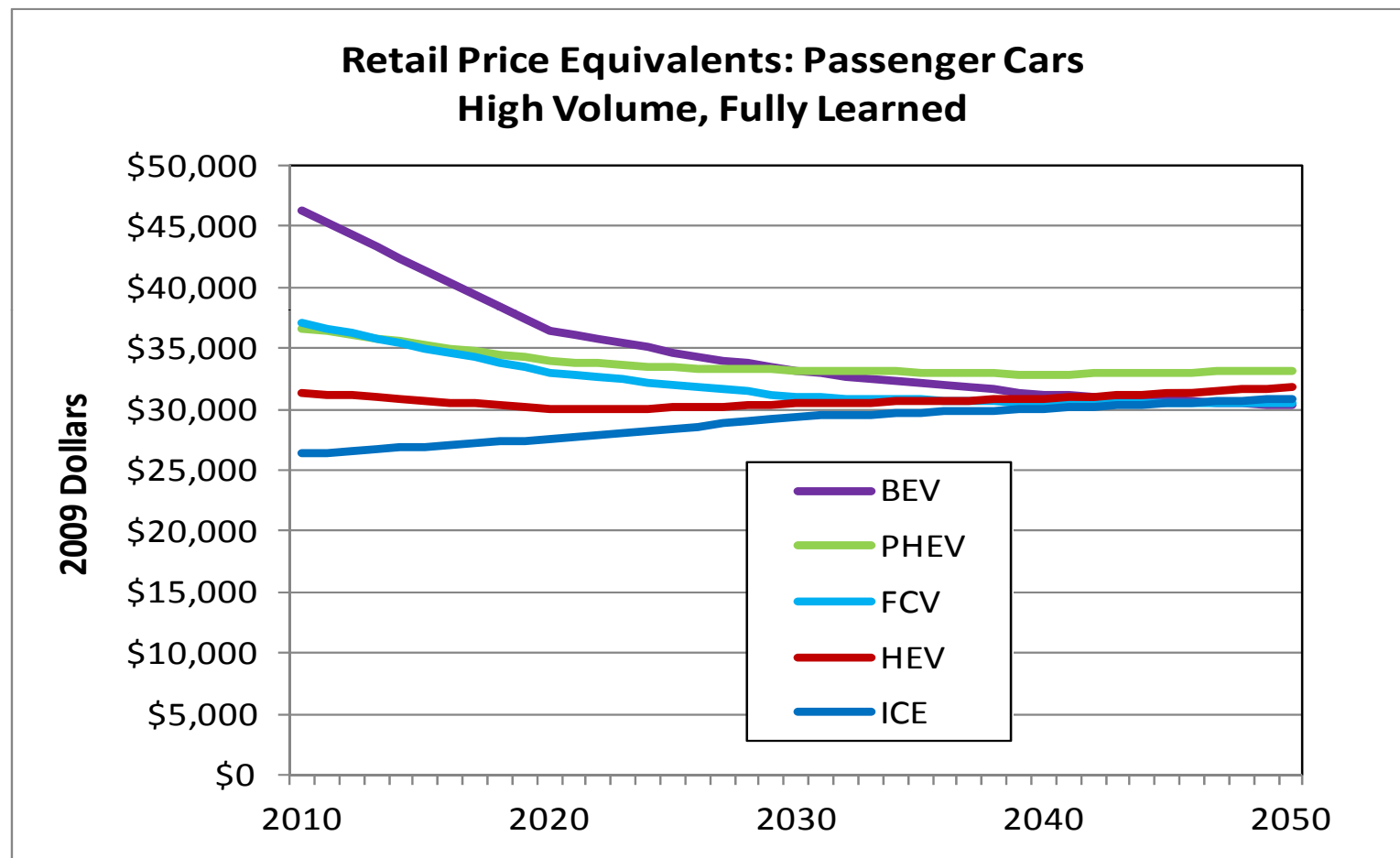
- In general, FCVs achieve higher deployment levels than BEVs
- Most scenarios result in mix of powertrains, but given adequate H<sub>2</sub> infrastructure larger share consistently goes to FCVs
- Without advance provision of H<sub>2</sub> infrastructure in California, FCV deployment is derailed nationwide
- PHEVs are transitional technology; do not achieve ongoing high deployment levels
- Petroleum prices do not strongly affect the pace of the transition
  - Less impact on consumer choice when all vehicles are highly efficient

# Basis for Conclusions

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- National Academy of Sciences Study: “Transitions to Alternative Vehicles and Fuels” March 2013
- Included new cost curves for existing and new drive trains prepared by John German (ICCT)
- Same model used by David Green for NAS and ICCT studies

# Fully Learned, High-volume Costs for BEVs and FCVs Become Lower than PHEVs, HEVs And ICEs



# Sustained Investment is Justified

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- Given expected technology progress and strong public policies, benefits of transition to electric drive appear to be about 10X greater than costs
- Additional investment is justified based on large benefits of achieving the transition
  - NPV of \$190-290B for CA and Section 177 states

# Efforts in California

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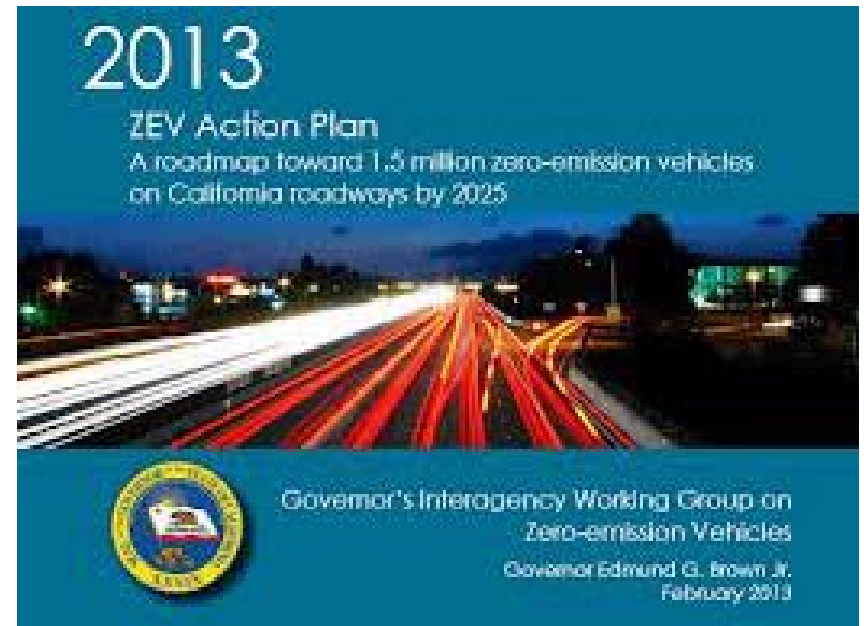
- California has a well developed effort by most stakeholders



# Governor's ZEV Action Plan

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- Action Plan goals
  - Complete needed infrastructure and planning
  - Expand consumer awareness and demand
  - Transform fleets
  - Grow jobs and investment in the private sector



[http://opr.ca.gov/docs/Governor's\\_Office\\_ZEV\\_Action\\_Plan\\_\(02-13\).pdf](http://opr.ca.gov/docs/Governor's_Office_ZEV_Action_Plan_(02-13).pdf)

# Plug-In Electric Vehicle Collaborative

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- Multi-stakeholder effort
  - Automakers, utilities, government, NGOs, infrastructure providers, researchers
- Working to ensure strong and enduring transition to plug-in market
- Focusing on workplace and multi-unit dwelling charging

<http://www.evcollaborative.org/>

# California Fuel Cell Partnership

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- Longstanding effort (since 1999)
- Automakers, energy companies, fuel cell technology providers, government
- Targeting infrastructure availability

<http://cafcg.org/>



# Electric Drive Needs Clean Electricity

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- Total decarbonization requires renewable energy for electricity for BEVs and H<sub>2</sub> for FCEVs
- California has 30% renewable requirement going to 50% by 2030
- Timing is right— future trend to distributed generation, self-generation and battery storage
- Potential to get off grid completely for BEVs
- Power to gas approach can provide renewable hydrogen and decarbonized natural gas supply

# Summary

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- Public health and climate concerns demand ultimate elimination of C and most combustion
- Transition will take time, and natural gas can play a role during this time
- Ultimate goal of e-drive with renewables is necessary and feasible
- Takes advantage of:
  - Reducing costs and increasing performance for BEVs and FCEVs
  - Trend to DG and self generation utilizing competitively available renewables
- While transition will require time and investment, it is viable, necessary and benefits are about 10x investment



Thank You!