



# GM Fuel Cell Technology & Status

California Energy Commission

Sacramento, 29Sep09

General Motors

Alex Keros

**DOCKET**

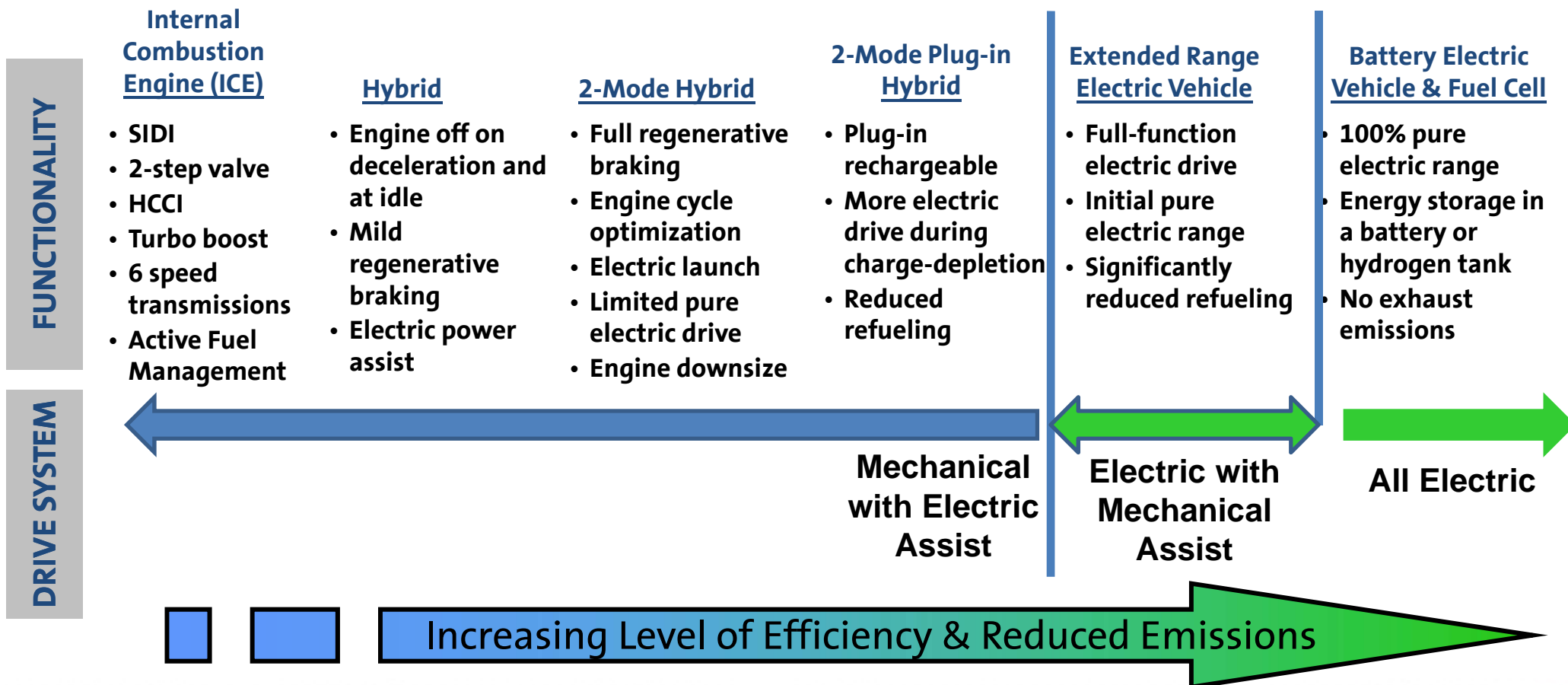
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# Vehicle Electrification

## Hybrid & Electric Drive Types & Benefits



# Project Driveway – World's Largest Fuel Cell Vehicle Fleet



## REAL WORLD DATA

- Over 80,000 customers applied
- 116 vehicles in four countries (50+ in California)
- 80 customer drivers
- Over 10,000 people total have driven the vehicles
- 13,000 fills/30,000 kg of H<sub>2</sub> = 60,000 gal of gasoline saved
- Performed through 2 winters
- Vehicles with over 25,000 miles
- Over 1,000,000 cumulative miles





# Project Driveway: Hydrogen Infrastructure



To support Project Driveway and encourage industry, GM invested >\$12M in H<sub>2</sub> Fueling equipment from multiple suppliers.

- Systems are GM owned/leased, installed, operated, and maintained.
  - In the last year, GM & its partners have completed “first-fills” on additional 8 fuelers
- Experience with Air Liquide, Air Products, Linde, Quantum, Hydrogenics. & others.
- Installations in multiple states (e.g. CA, NY) & countries (North America, Europe).
- Comprehensive Learning: Technology Development to Project Management
  - Complete data tracking from fill time to part replacement to customer experience.
  - Several systems with greater than 5,000 kg's delivered.
  - “Handshake to First Fill” in less than 5 months at Clean Energy LAX.





# Standard Program Timing for 2015 Launches

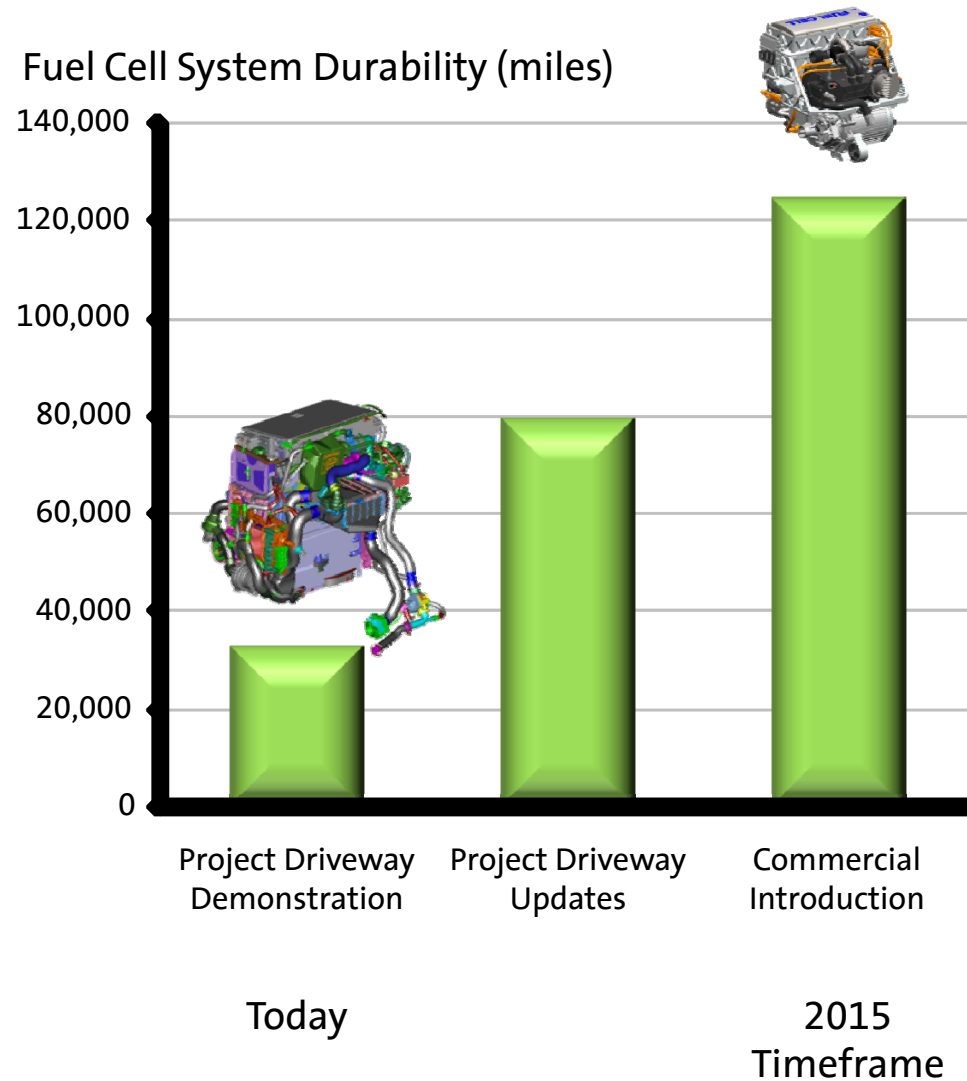


- Next step: Reasonable Automotive Volumes
  - Technology Pre-development Complete
  - Evaluation:
    - US government policy
    - Infrastructure initiatives
    - OEM/Customer Incentives

# GM Fuel Cell Systems Durability



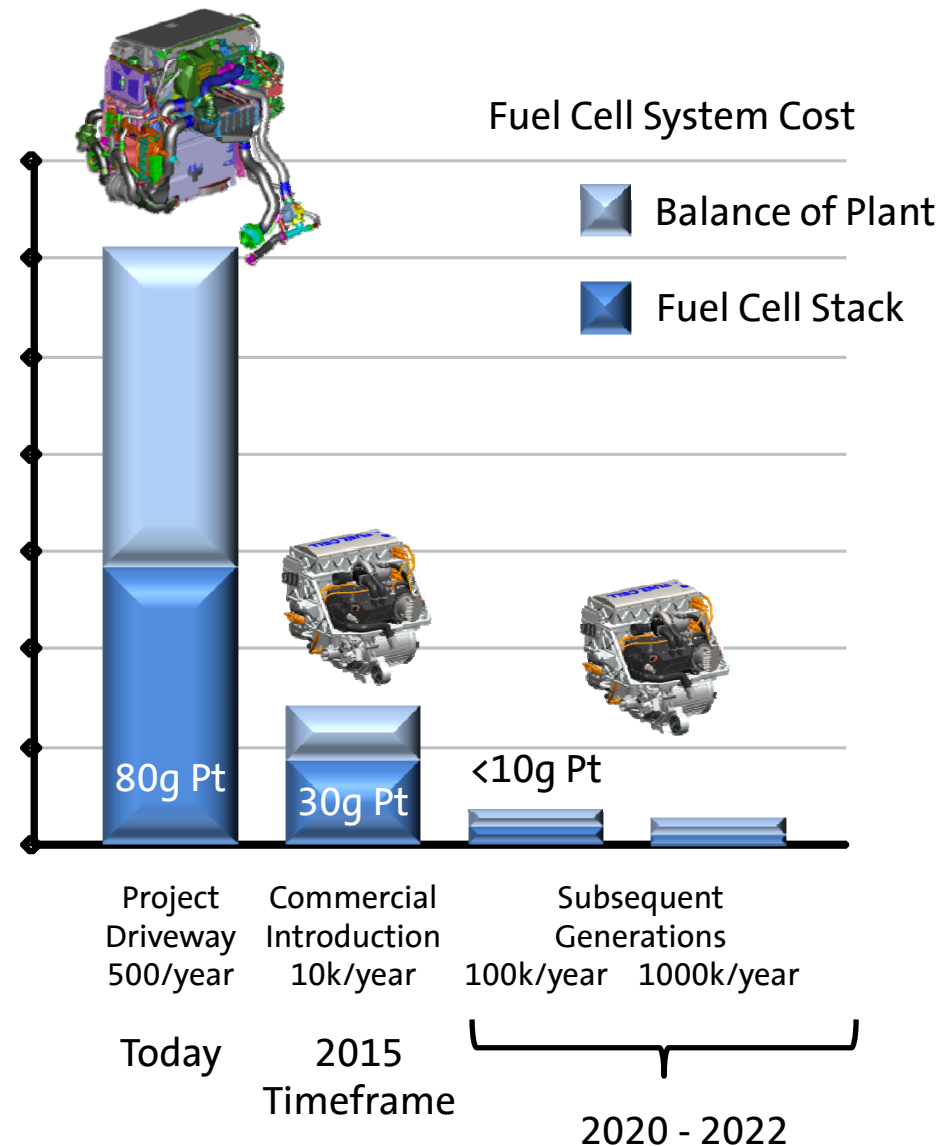
*Next Generation systems are on glide path to meet commercial durability*



# GM Fuel Cell Systems Cost



*Next Generation systems are on glide path to meet commercial cost*



# Roadmap for Accelerating Fuel Cell-Electric Vehicle Innovation



## Enablers

- **Research:** Continued DOE-funded research grants
- **Product Development:** Development and Investment incentives for OEMs and suppliers
- **Commercial Deployment:** Incentives for infrastructure deployment, customer purchase (tax credit) and education, energy policy (carbon/CO<sub>2</sub> tax), OEM incentives (CAFE/CO<sub>2</sub>, FE regulation)

## Barriers

- High development and deployment costs during Gen 1 and 2 borne by OEMs without much ability to recover pricing from consumers
- Refueling infrastructure deployment coordinated with vehicle deployment
- Risk due to price volatility of oil/gasoline
- Inconsistent public policy, which creates disincentives for private investment

Lack of US long term energy and environmental strategy and funding/signal from key agencies (DoE, DoD), has added significant risk to the technology development  
- - Appreciate CA continued engagement with key agencies



# GM Competitive Position in Fuel Cell Technology

GM is the only domestic OEM with in-house automotive experience



- GM developed a leadership position
  - GM has over 20 years experience & invested >\$1B
  - GM is operating world's largest fuel cell vehicle fleet (Project Driveway)
  - GM established technology strength in electrochemistry, materials, systems engineering, modeling and packaging
- In total, U.S. Government & Companies invested over \$3B
- Given co-dependence of high volume vehicle introduction & refueling infrastructure, GM has invested to remain among the fuel cell leaders
  - Need consistent and long term government policy supporting fuel cell and hydrogen commercialization
  - Need funding initiatives and H<sub>2</sub> infrastructure development) in light of significant economic challenges

# Closing Comments



- GM continues to aggressively pursue fuel cell technology option
- Technology spending and investment is at significant risk, given financial challenges
- National policy initiatives are necessary to enable payback for advanced propulsion technologies, esp. fuel cells and related hydrogen infrastructure

## Requests to CEC:

- Appreciate continued engagement with key agencies
- Need support for maintaining the existing infrastructure & expanding infrastructure
- Need everyone's support to keep the option going at the federal and state levels
- Complete comprehensive analytical tool on “executable” hydrogen infrastructure plan
  - NG to Renewables plus Requirements , Risks, & Outcomes in Key Priority areas in CA
  - GM will support inputs into such a model



# Additional



## **GM's Gen 2 Fuel Cell System Cuts Size, Weight and Cost**

*System with 5th Generation Fuel Cell Stack Could Be Commercialized in 2015*

Washington, D.C. -- The second generation hydrogen fuel cell system in development by General Motors Co. is half the size, 220 pounds lighter and uses less than half the precious metal of the current generation in the Chevrolet Equinox Fuel Cell electric vehicle.

And the production intent fuel cell powertrain can be packaged under the hood in about the same space as a four-cylinder engine. It contains GM's fifth-generation fuel cell stack, which could be commercialized in the 2015 time frame.