FCVs and the Consumer

Hydrogen & Fuel Cell Technical Advisory Committee
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Toyota Motor North America

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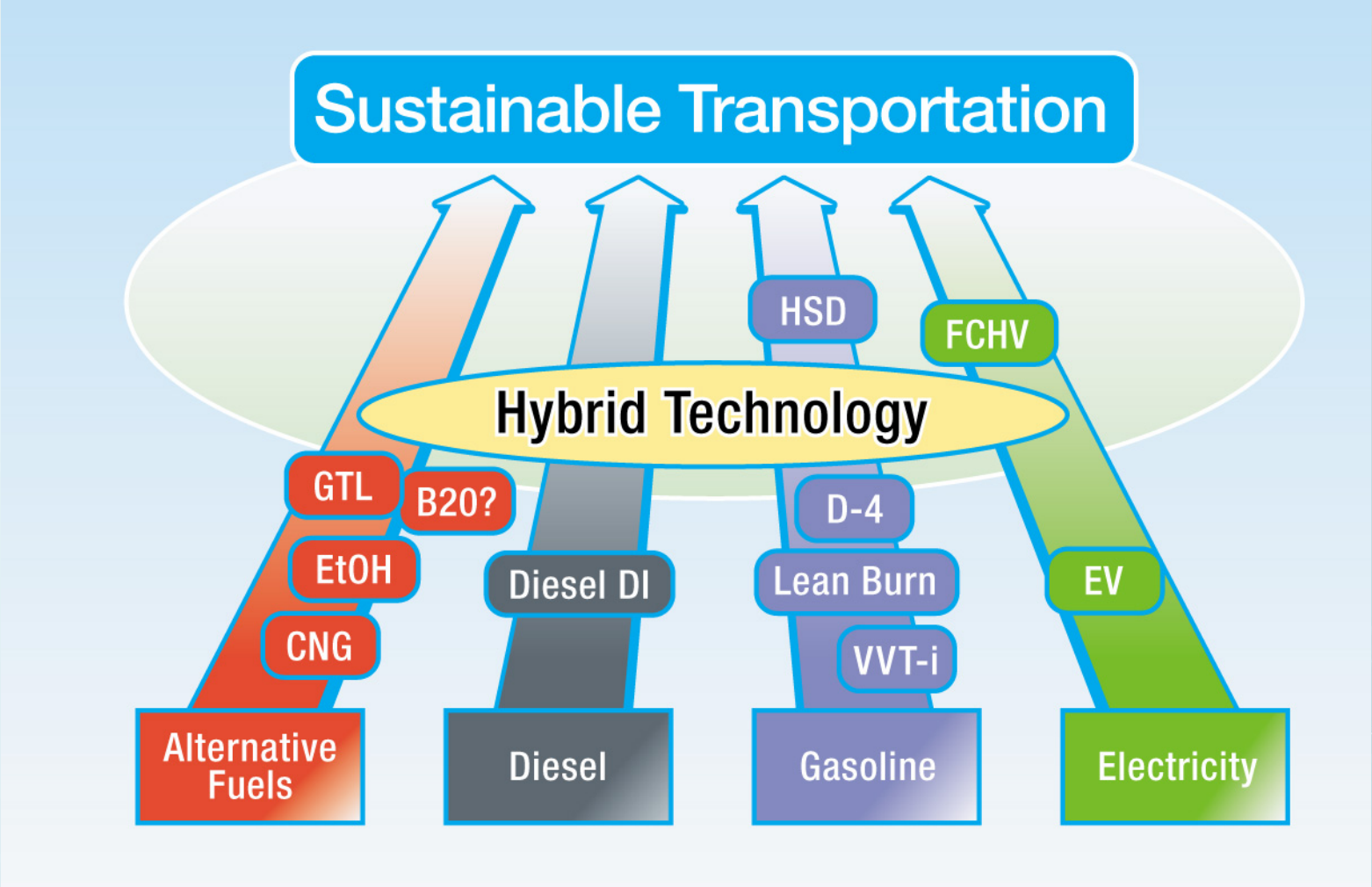
TOYOTA

Multiple Approaches Required



Hybrid Expansion is the Foundation

Toyota Prius
50 MPG

Prius *v*
42 MPG

Prius *c*
50MPG

Toyota Prius Plug-in
95 MPGe/50 MPG

Toyota Camry LE
41 MPG

Toyota Highlander
28 MPG

Toyota Avalon Hybrid,
40 MPG

Lexus LS600hL
20 MPG

Lexus GS 450h
31 MPG

Lexus CT 200h
42 MPG

Lexus ES 300h
39 MPG

Lexus RX 450h
30 MPG

Fuel Economy – EPA MPG (Combined); Actual mileage will vary.

Deploying a Range of Adv. Technology Vehicles

Available in California

Fleet Demo Program

Available in 14 States

Coming to Market in 2015

Requirements for FCV Commercialization

- The Vehicle
  - Performance, manufacturing and cost

- The Market
  - Consumer desire and incentives

- Refueling Infrastructure
  - Available, convenient & reliable

FCV Commercialization
Report Card
1st Qtr 2013

Vehicle	B+
Market	C-
Infrastructure	D

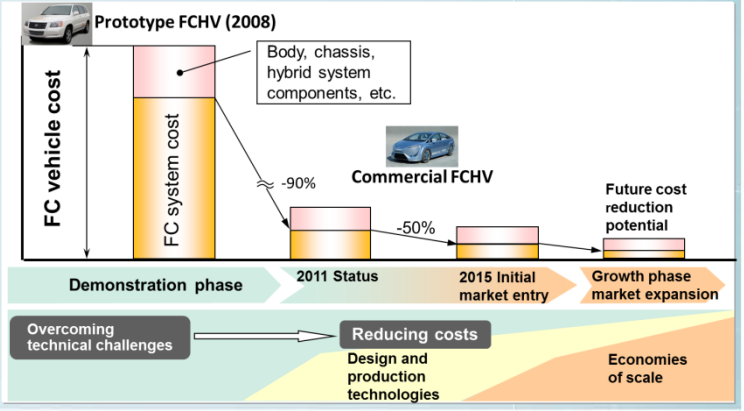
The Fuel Cell Vehicle

- Commercial fuel cell system design complete
  - FC Stack, BOP, H2 tanks, battery & drive system
- Performance – meeting internal 2015 targets
  - Real-world testing under way
- Manufacturing – Greater use of automation
  - Developing new processes and equipment
  - Higher volumes, improved QC & lower cost
- FC System Cost – Targeting ~95% reduction
  - System simplification
  - Power density
  - Design for manufacture

Performance Score Card

Attribute	*Similar to ICE Vehicle*
Fuel Efficiency	✓
Range	✓
Refueling Time	✓
Performance	✓
Cold / Hot Start	✓
Durability	✓
Reliability	✓
Cargo Space	✓

Continuous FCV Cost Reduction



BMW / Toyota Partnership

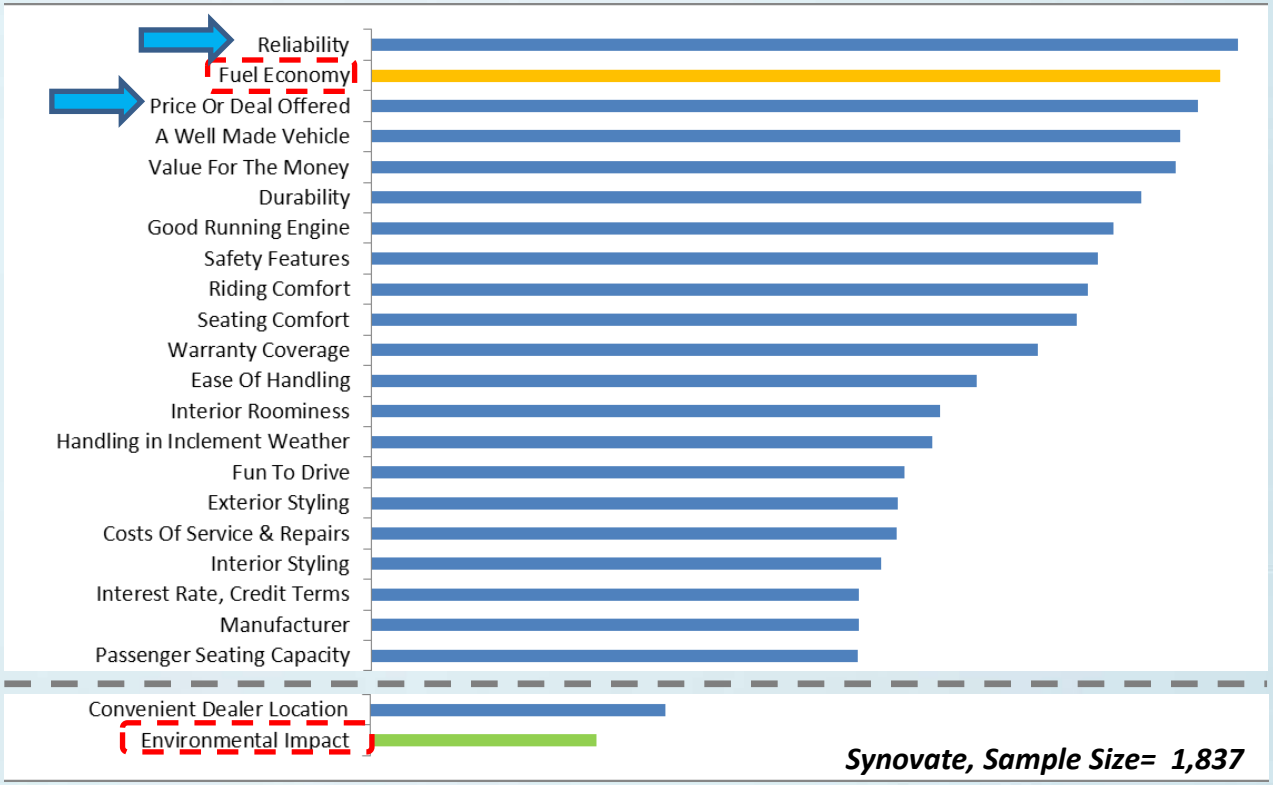
- A binding long-term collaboration in the field of sustainable mobility
- Collaboration on four development projects

1. Fuel Cells
   - BMW and Toyota will share technologies and to jointly develop a fuel-cell vehicle system for completion in 2020
     - Fuel cell stack, BOP, hydrogen tank, motor and battery
   - Collaborate in the development of codes and standards for H2 infrastructure
2. Sports Vehicle
   - Conduct feasibility study to define a joint platform concept for a mid-size sports car
3. Lightweight Technology
   - Jointly develop lightweight technologies for vehicle bodies using reinforced composites
4. Post-lithium-battery technology
   - Joint research to develop a lithium-air battery

Market – PEV Experience

- PEV marketing & sales experience provides useful insight for FCVs
  - Must look beyond "Early Adopter"
  - Environmental Impact is not important to mass market

Most Important Characteristics for Next Vehicle Purchase



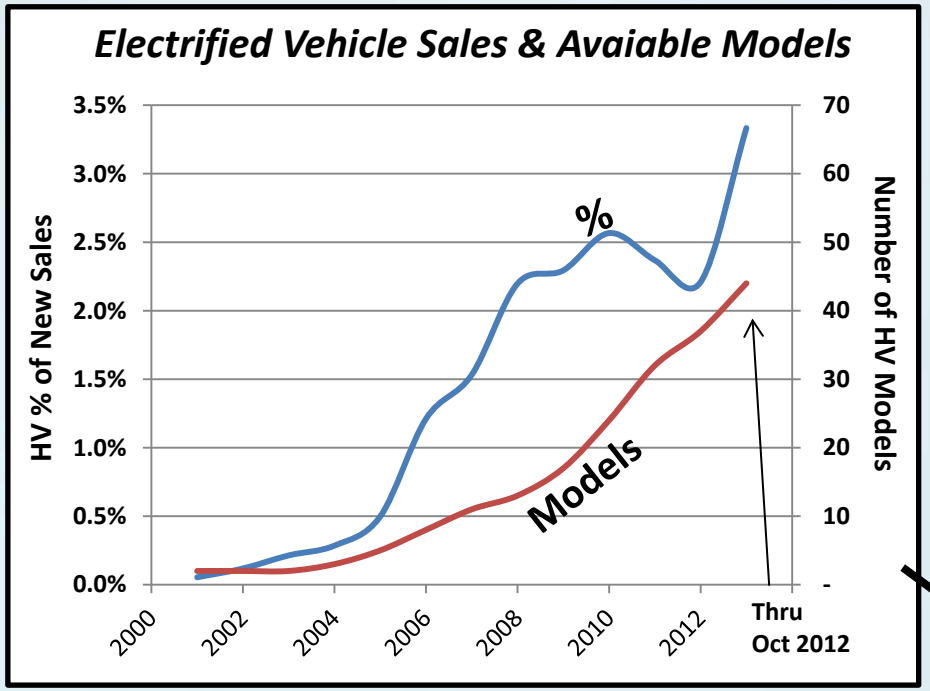
Source: Synovate Study, 2011

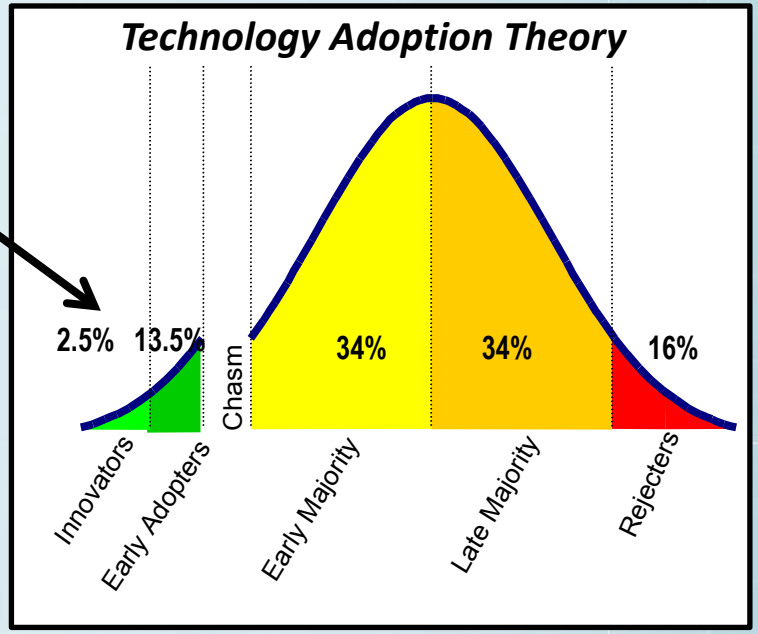
"Fuel Economy" Is 2nd

Q) In considering your next purchase of a new vehicle, please select the vehicle characteristics/ features from the list below that will be important in the decision process.

"Environmental Impact" is 36th (of 52)

Technology Adoption Accelerating





- Best year yet for electrified vehicle sales
- Not yet mainstream – must jump chasm

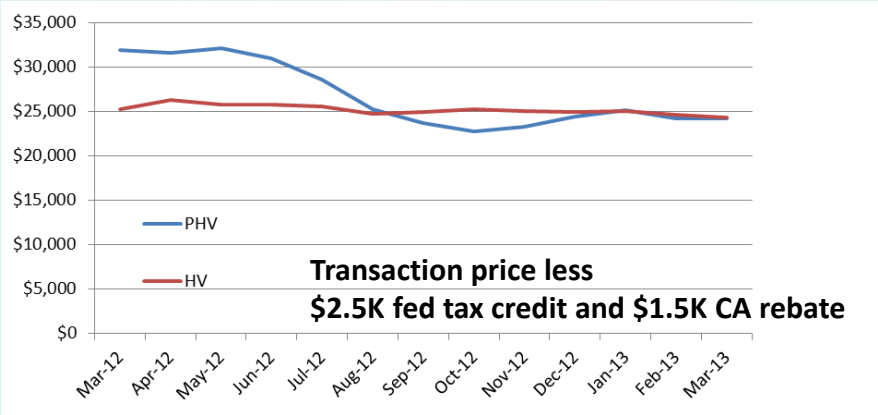
The Market - How to Interest Consumers in FCVs

- Mass market consumers appear unwilling to pay premium for PEVs
  - Incentives required to maintain sales
  - Similar or greater incentives needed for FCVs

- Must differentiate FCVs from PEVs in mind of consumer

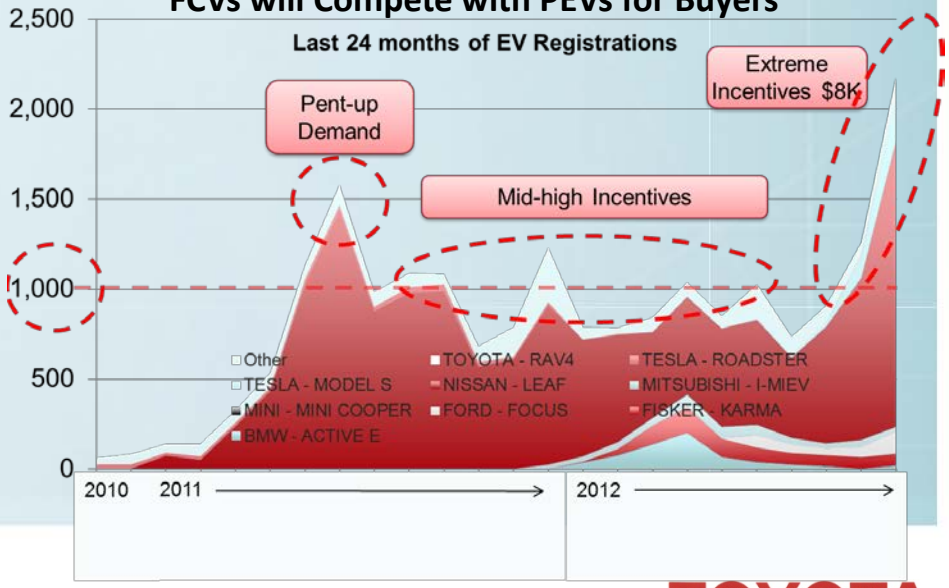
- Knowledge about vehicle ≠ desire

Prius Plug-in vs. Prius Hybrid Transaction Price



Source: PIN

FCVs will Compete with PEVs for Buyers



Deployment Determined by H2 Infrastructure

- Many countries investing in hydrogen infrastructure
- Manufactures will deploy FCVs in regions with adequate infrastructure

Hydrogen Infrastructure

- H2USA LOU between DOE and industry
  - Shows DOE's renewed support for FCVs & H2 infrastructure
  - Will accelerate H2 infrastructure development outside of CA
- Southern CA H2 infrastructure growing slowly
  - Number of stations unlikely to reach initial 2015 targets
- To assure consumer satisfaction, H2 station must be
  - Reliable, convenient & in attractive locations
  - Consider backup refueling capability in case a station is inoperable
- Current station construction dependent on public funding
  - Must improve ROI via incentives and tax policy (construction and/or O&M)
- Work still required on codes and standards, & consistent building / fire codes

Keys to Fuel Cell Vehicle Success

- ⇨ ***FCVs need to perform like conventional autos***
  - ⇨ ***Market unlikely to accept significant price premium (incentives critical)***

- ⇨ ***Consumers need to value and desire FCV benefits***
  - ⇨ ***Education should focus on mainstream buyer***

- ⇨ ***Convenient, dependable & comfortable refueling experience***
  - ⇨ ***A must with limited refueling infrastructure***

- ⇨ ***Sustained consistent policy needed to allow technology diffusion***
  - ⇨ ***Hybrids took over 10 years to reach 3% of market***

Thank You For Your Attention