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King Abdullah Petroleum Studies and Research Center

Understanding demand for hybrid and plug-in electric vehicles in the U.S. using large-scale consumer profile data

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Background

- Supply-side policies such as federal and state-level programs are steering automakers to sell hybrids and plug-in electric vehicles (collectively termed xEVs, where x could be H, PH or B)
  - Greenhouse Gas Emissions (GHG) and Corporate Average Fuel Economy (CAFE) programs
  - Zero Emission Vehicle (ZEV) regulation in California and Section 177 states*
- Targets have been set as to achieve long term GHG reduction, air quality improvement and energy security
- Success depends upon consumer adoption

*Section 177 States: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, Vermont

Objective & Findings

- Understanding current xEV buyers
  - Tech-savvy, environment friendly, high fuel economy conscious, multi-vehicle, high income households
- Understanding potential xEV market size under current market and regulatory environment
  - If we freeze the current (MY 2015) market and regulatory conditions, the xEV (HEV+PHEV+BEV) market share could at best reach up to ~ 11 percent in the U.S.
- Understanding consumers' desires that can help in achieving market share beyond the estimated potential
  - Fulfilling consumers' desires related to reliability, handling, high value for money proposition, fun to drive/performance and exterior styling
- Identifying macro levers (policies) for nudging micro (consumer-level) factors in the intended direction
  - Policy mix of supply-side and demand-side policies and fuel price

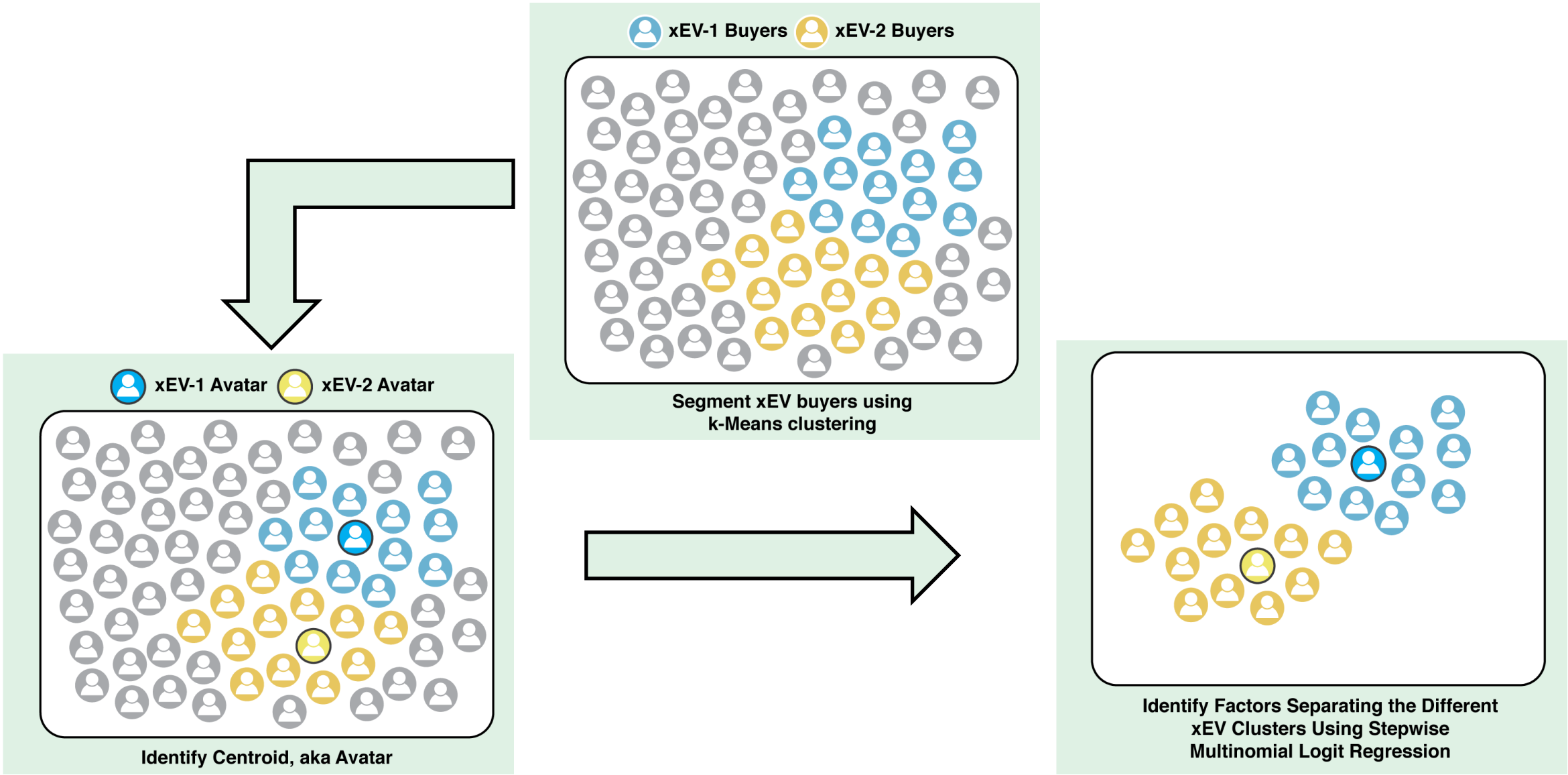
Data – Strategic Vision New Vehicle Experience Survey (NVES)

- Nationally representative survey data of new car buyers in the U.S.
- 11 years of annual NVES data from MY 2005 – MY 2015
- Annual number of respondents range from 29,660 in 2005 to 105,691 in 2015; maximum of 191,568 in 2012

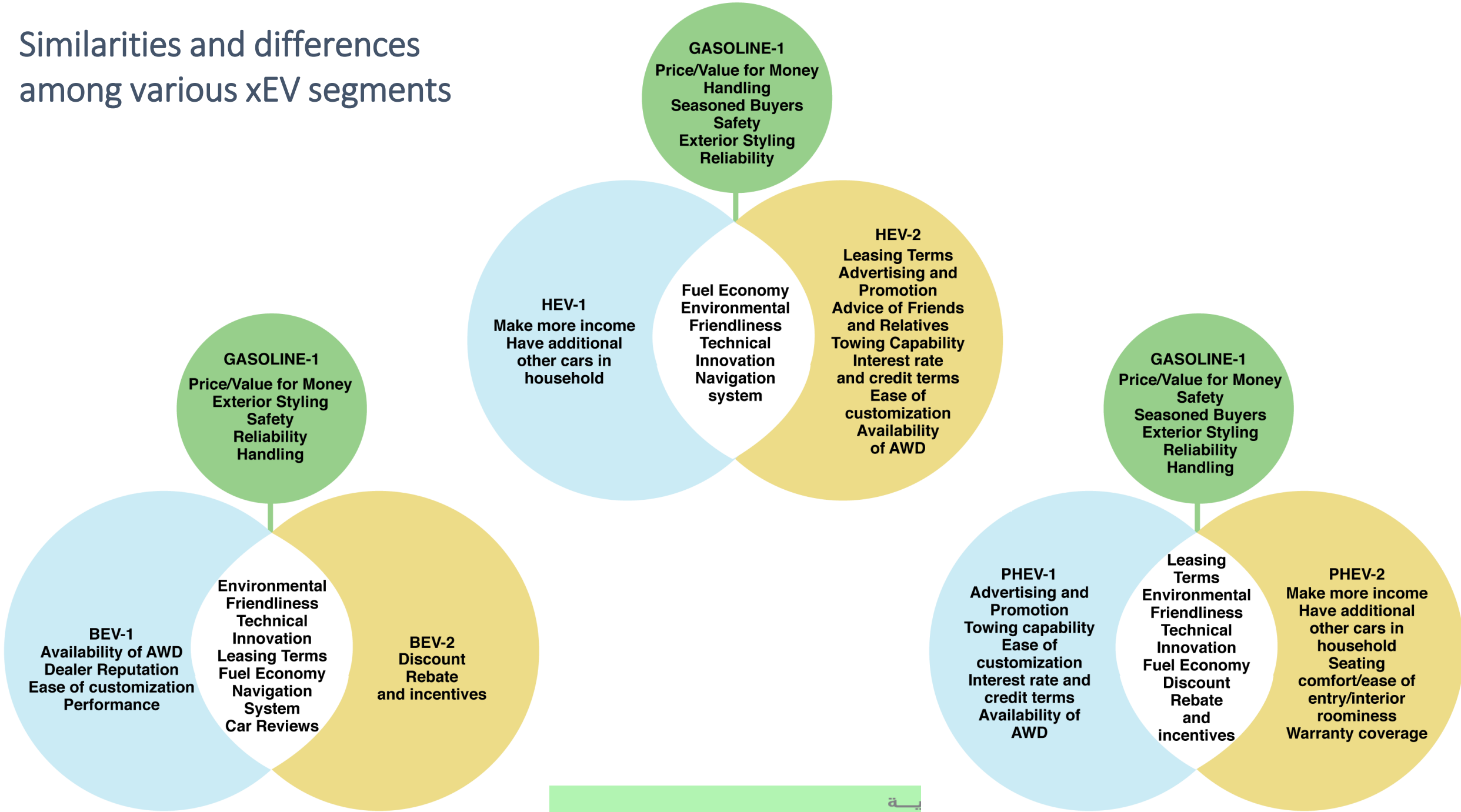
Purchase Reasons	Demographics
Fuel Economy	Total Number of Children
Leasing Terms	Total Other Vehicles Owned/Leased
Environmentally Friendly	Income
Exterior Styling	Age
Price/Monthly Payment	–
…	–
Technical Innovations	–

Understanding current xEV buyers

Identifying Different Types of xEV Buyers



Similarities and differences among various xEV segments

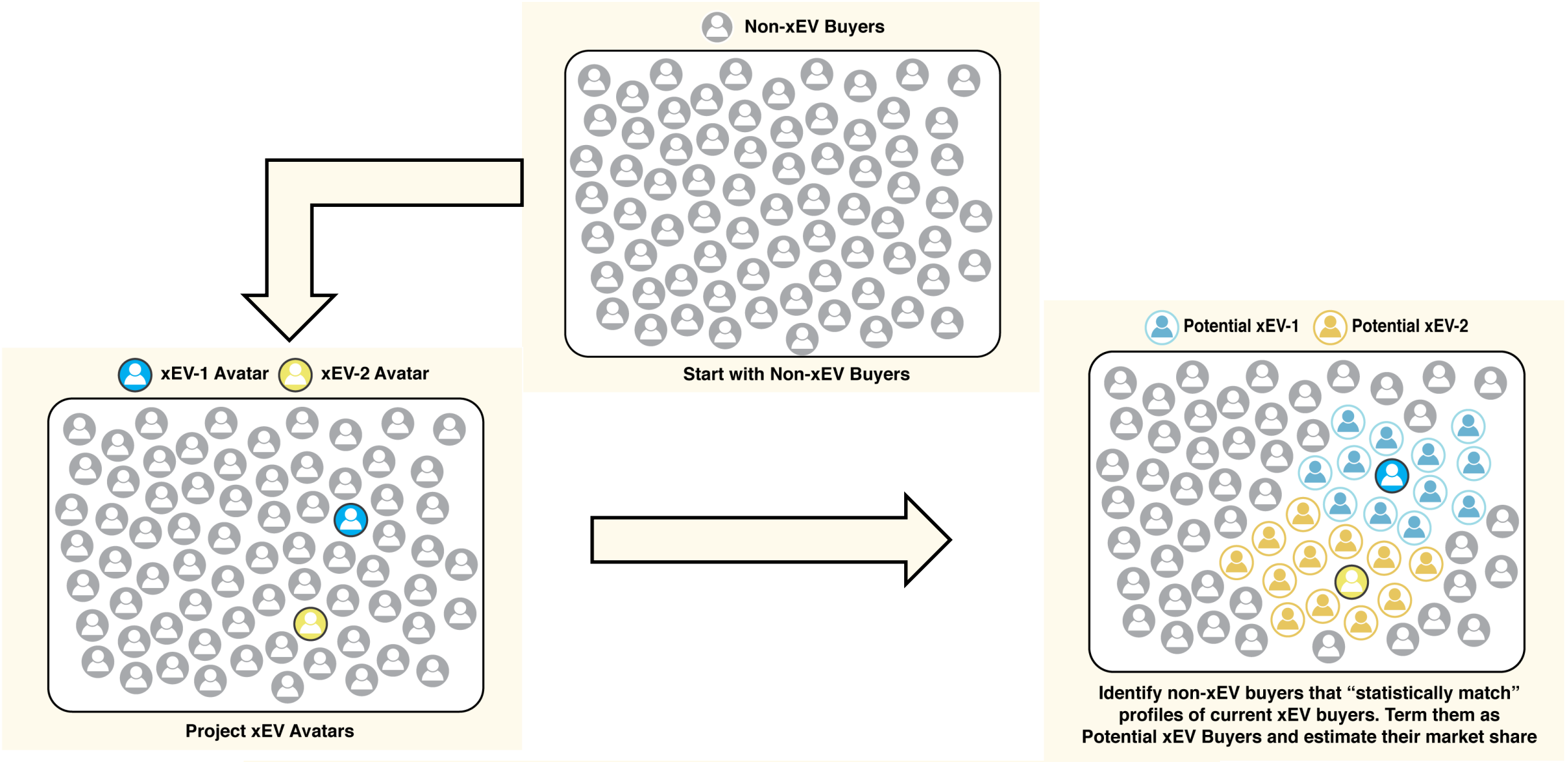


Top 5 models purchased by xEV fuel type buyers

HEV-1	HEV-2	PHEV-1	PHEV-2	BEV-1	BEV-2
Toyota Prius	Toyota Prius	Chevrolet Volt	Chevrolet Volt	Tesla Model S	Nissan Leaf
Toyota Prius c	Toyota Prius c	Ford Fusion Plug-in	Ford Fusion Plug-in	Nissan Leaf	Fiat 500e
Toyota Prius v	Toyota Camry Hybrid	Ford C-MAX Energi	Ford C-MAX Energi	Fiat 500e	Chevrolet Spark EV
Toyota Camry Hybrid	Toyota Prius v	Toyota Prius Plug-in	Toyota Prius Plug-in	Mercedes BEV	Tesla Model S
Ford Fusion Hybrid	Lexus CT200h		Honda Accord Plug-in Hybrid Sedan	Ford Focus Electric	BMW i3 Hatchback

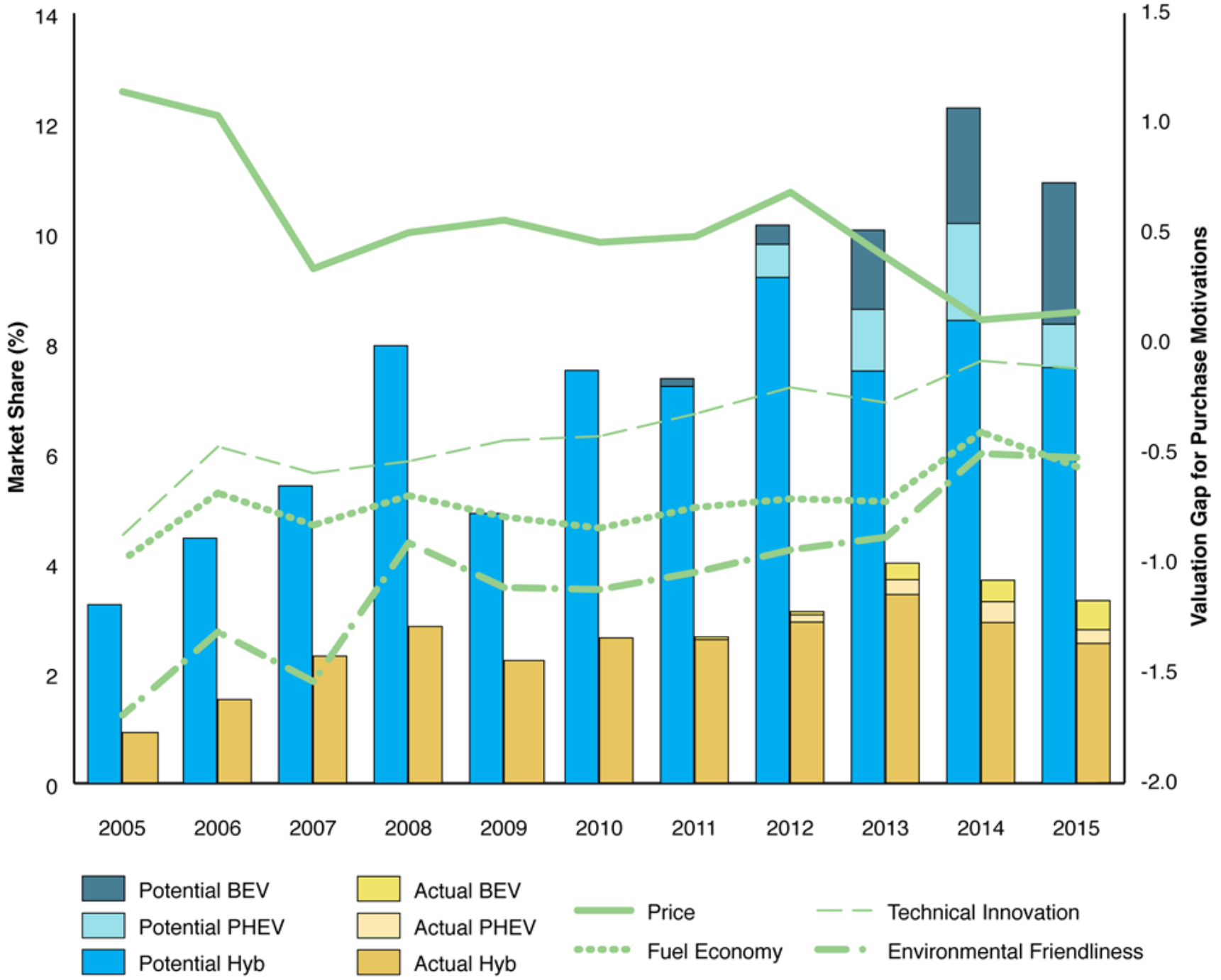
Understanding potential xEV market size under current market and regulatory environment

Identifying Potential xEV Buyers



Dua, R., White, K. and Lindland, R. (2017) Understanding Potential for Battery Electric Vehicle Adoption Using Large-Scale Consumer Profile Data, Transportation Research Board Proceedings

Actual & Potential Market Share for xEVs



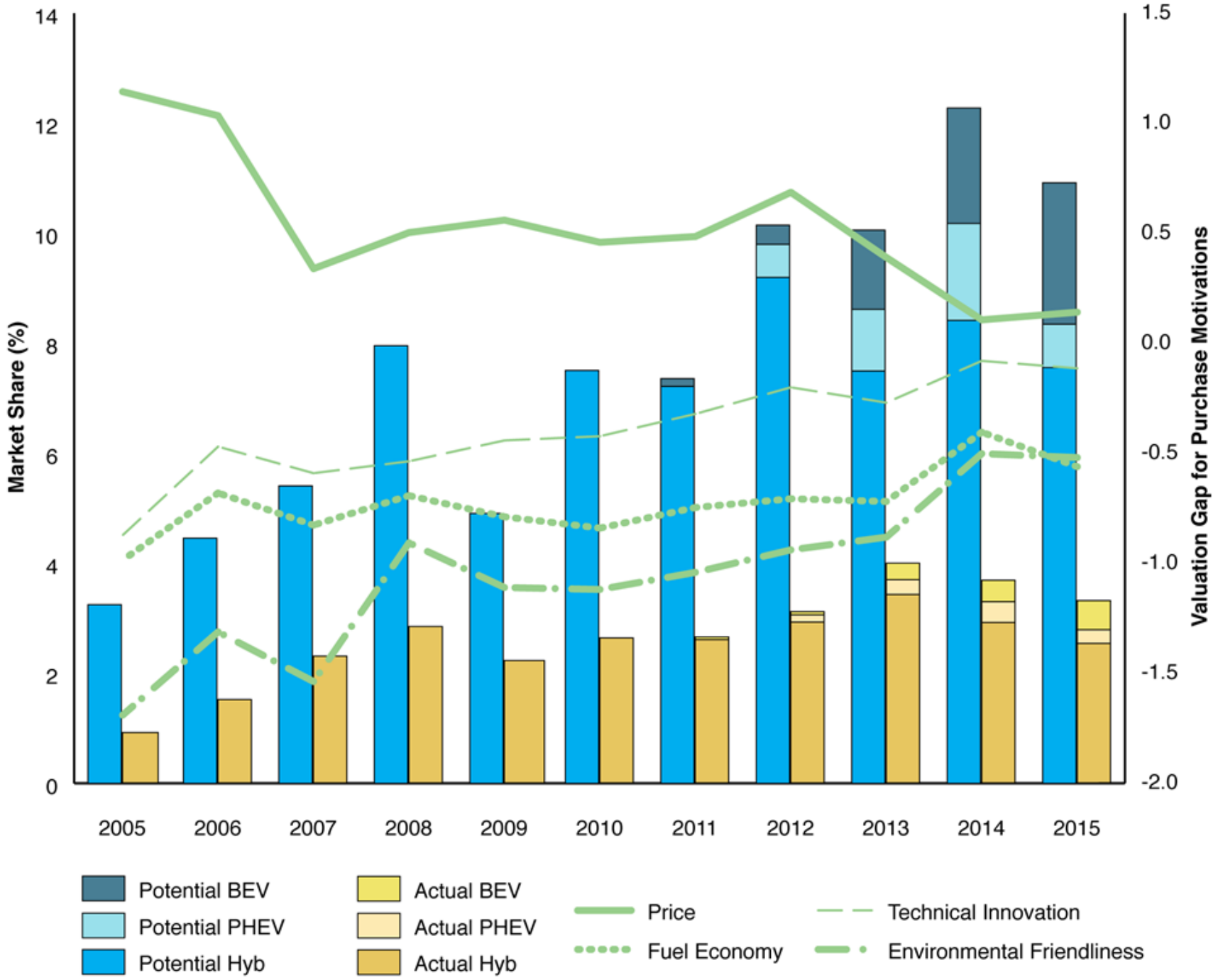
Difference between non xEV and xEV Consumers' Valuation of Purchase Motivations

Achieving estimated potential market and beyond

	Achieving the estimated *"best case"* potential market share	Achieving market share beyond estimated potential
	Factors and features that potential xEV buyers care more about than current xEV buyers	Factors and features that both current and potential xEV buyers are currently willing to trade off
HEV-1 (MY 2015)	Dealer reputation Safety	Value for money Fun to drive Exterior styling Handling Availability of AWD Demographics* - Younger; Lower income
PHEV-2 (MY 2015)	Interior roominess Dealer reputation Manufacturer reputation	Price/value for money Handling Safety Ease of customization Towing capability Demographics* - Younger
BEV-2 (MY 2015)	Exterior styling Warranty coverage Future trade-in/resale value	Price/value for money Reliability Handling Dealer reputation Interior options Demographics* - Younger; Lower income

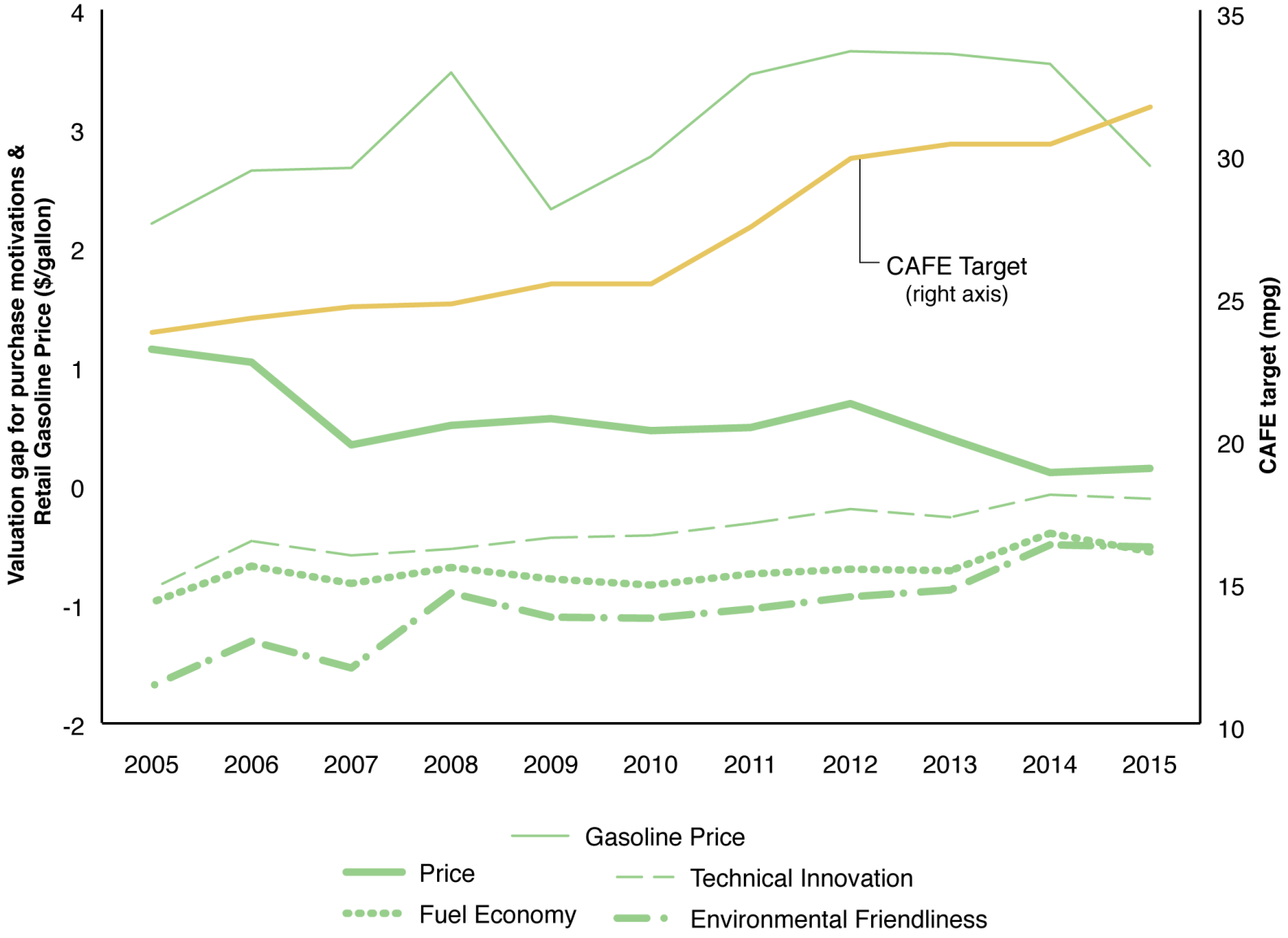
Identifying macro levers (policies) for nudging micro (consumer-level) factors in the intended direction

Actual & Potential Market Share for xEVs



Valuation Gap between non xEV and xEV Consumers' Valuation of Purchase Motivations

Linkage between micro (consumer-level) factors and macro policy instruments



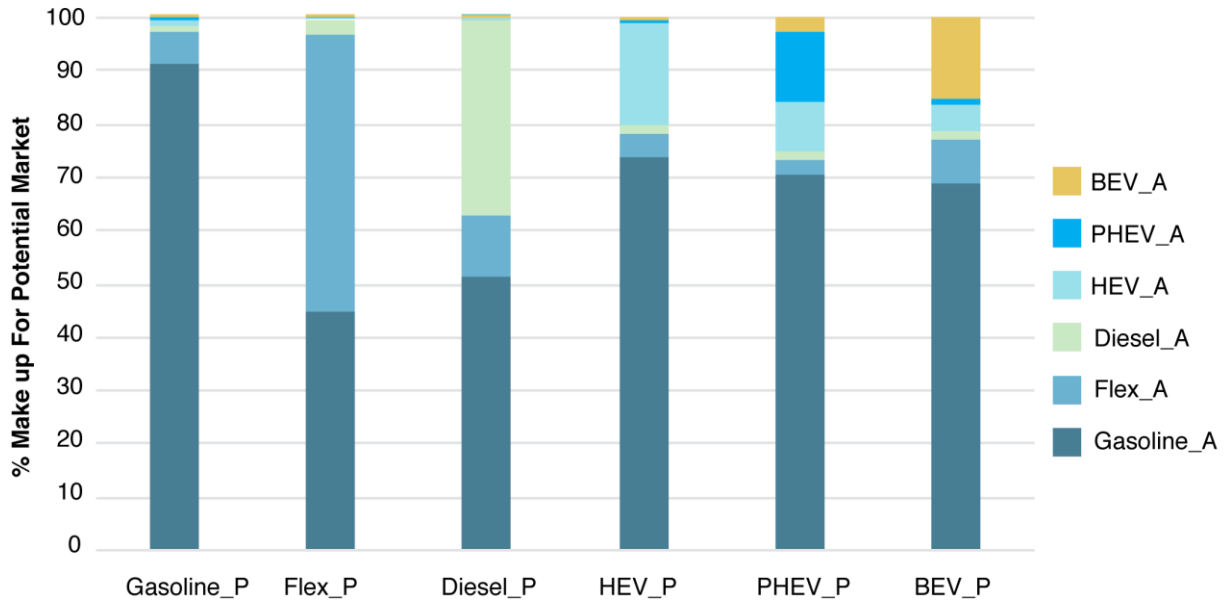
Thank You

Can all xEVs sales grow simultaneously?

Top 10 models purchased by potential xEV fuel type buyers

Potential HEV	Potential PHEV	Potential BEV
Toyota Camry	Kia Soul	Toyota Corolla
Toyota Corolla	Nissan Altima Sedan	Toyota Camry
Honda Civic Sedan	Volkswagen Jetta Sdn / GLI Sdn	Subaru Outback Wgn
Honda Accord Sedan	Honda Civic Sedan	Toyota RAV4
Nissan Altima Sedan	Toyota Prius	Kia Forte Sedan
Hyundai Elantra Sedan	Hyundai Sonata	Nissan Rogue
Honda Fit	Ford Fusion	Chevrolet Equinox
Hyundai Sonata	Honda Accord Sedan	Mazda CX-5
Honda CR-V	Chevrolet Camaro	Nissan Altima Sedan
Chevrolet Cruze	Ford Edge	Honda Accord Sedan

Percentage makeup for potential market for each fuel type



Valuation Gap