



DAWG Transportation Subgroup Follow-Up

Transportation Energy Forecasting Unit

October 9, 2017

Demand Analysis Working Group

Transportation Forecast



Meeting Summary

■ Agenda:

- Introductions
- Timeline and process for selecting cases for Demand Forecast (Siva Gunda).
- Overview of stakeholder comments (Mark Palmere).
- Explain scenario options (Aniss Bahreinian).
- Electric vehicle attributes (Sudhakar Konala).
- Discussion.

■ Objectives:

- Explain process behind developing each case.
- Provide information on rationale behind assumptions.
- Stakeholders understand scenario options.



Timeline and Process



Comments at August 23 Meeting

What we heard from you:

- There was a general consensus amongst the members and attendees that TEFU should consider a scenario where PEVs are available in more LDV classes.
- For battery prices, there was a strong consensus that Bloomberg's battery prices should be used for the high demand case. (Some wanted it for the mid, others said at least high). Also, the Bloomberg Bottom Up Case (\$89/kWh in 2030) is a higher price than the Bloomberg Learning Curve Case (\$73/kWh in 2030).
- There was some belief in ZEVs reaching price parity with ICEs by 2030, however this was not a general consensus.
- There was all around consensus that preferences for ZEVs are increasing, but no consensus on by how much.



Alternate Scenarios (from August Meeting)

Scenario Number	1	2	3	4	5	6	7	8
Scenario Name	Pessimistic PEV	Low PEV	Mid PEV	High PEV	High PEV 2	Aggressive PEV	Aggressive PEV 2	Bookend PEV
Gross State Product	IEPR Low Demand Case	IEPR Low Demand Case	IEPR Mid Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case
Personal Income	IEPR Low Demand Case	IEPR Low Demand Case	IEPR Mid Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case
Number of Households	IEPR Low Demand Case	IEPR Low Demand Case	IEPR Mid Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case	IEPR High Demand Case
Gasoline Prices	Low Prices	Low Prices	Mid Prices	High Prices	High Prices	High Prices	High Prices	High Prices
Natural Gas Prices	High Prices	High Prices	Mid Prices	Low Prices	Low Prices	Low Prices	Low Prices	Low Prices
Electricity Prices	High Prices	High Prices	Mid Prices	Low Prices	Low Prices	Low Prices	Low Prices	Low Prices
Rebates	PEV Rebate to 2020	PEV Rebate to 2020	PEV Rebate to 2025	PEV Rebate to 2030	PEV Rebate to 2030	PEV Rebate to 2030	PEV Rebate to 2030	PEV Rebate to 2030
Tax Credits	PEV Tax Credit to 2020	PEV Tax Credit to 2020	PEV Tax Credit to 2025	PEV Tax Credit to 2025	PEV Tax Credit to 2025	PEV Tax Credit to 2030	PEV Tax Credit to 2030	PEV Tax Credit to 2030
HOV Lane Access	BEV Only	BEV and PHEV	BEV and PHEV	BEV and PHEV	BEV and PHEV	BEV and PHEV	BEV and PHEV	BEV and PHEV
Fuel/Technology Type & Parameter	All	All	All	All	All, Augmented Preference for PEV	All+PHFCV from 2025, Preferences for PEV increase @ 2.5% a year	All+PHFCV from 2022 + Preferences for PEV increase @5% a year	All+PHFCV from 2022 + Preferences for PEV increase @10% a year
Vehicle Class	Most Likely	Most Likely	Most Likely	Number of Classes Augmented for PEV - 1	Number of Classes Augmented for PEV - 1	Number of Classes Augmented for PEV - 2	Number of Classes Augmented for PEV - 2	PEVs in all classes
ZEV/PEV Alternative Specific Constants	As Estimated	Constant After 2017	Constant After 2017	Constant After 2017	Constant After 2017	Constant After 2017	Constant After 2017	Constant After 2017
Vehicle Price	PEV 25% Above Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Bloomberg battery price-based	PEV 25% Below Most Likely	Parity or lower at 2030
Fuel Economy	PEV 25% Below Most Likely	PEV 25% Below Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely
Maintenance Cost	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely
Range	PEV 25% Below Most Likely	Most Likely	Most Likely	Most Likely	ARB High Tech	ARB High Tech	PEV 25% Above Most Likely	PEV 25% Above Most Likely
Acceleration	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely	Most Likely
# of Makes and Models	PEV 50% Below Most Likely	PEV 25% Below Most Likely	Most Likely	Most Likely	Most Likely	PEV 50% Above Most Likely	PEV 50% Above Most Likely	PEV 50% Above Most Likely
Refueling Time	PEV 25% Above Most Likely	PEV 25% Above Most Likely	Most Likely	PEV 25% Below Most Likely	PEV 25% Below Most Likely	PEV 25% Below Most Likely	PEV 25% Below Most Likely	PEV 25% Below Most Likely
Time to Refuel Station	PEV 25% Above Most Likely	PEV 25% Above Most Likely	Most Likely	Most Likely	Most Likely	PEV Same as gasoline	PEV Same as gasoline	PEV Same as gasoline



Description of PEV Scenarios

- **LOW:** Least favorable for plug-in electric vehicles (PEVs), driven by a combination of lower economic & demographic growth, fewer government incentives, and lower gasoline prices. While improvements in the PEV characteristics (such as lower vehicle prices, higher range, etc.) are anticipated, such advances are expected to be slower. Furthermore, preferences for PEVs are assumed to show little to no improvement through the forecast period.
- **MID:** Represents what staff anticipates to be the most likely set of forecast inputs based on research, professional judgment, as well as stakeholder input. The scenario combines moderate economic and demographic growth, likely fuel prices, and increasing consumer preferences for PEVs, and the PEV characteristics most likely to be available in the market place over the forecast period.
- **HIGH:** Uses a set of inputs that are more favorable for market uptake of PEVs. The scenario assumes higher economic and demographic growth, higher gasoline and diesel prices, as well as greater than expected advancements in battery technology and market availability. It assumes lower battery/vehicle prices, higher range, but the same number of classes as in the mid case.
- **AGGRESSIVE:** Uses a set of inputs that are very favorable for market uptake of PEVs. The scenario uses the same economic and demographic growth, gasoline and diesel prices as the high scenario, as well as greater than expected advancements in PEV technology and market availability, combined with an increased consumer preference towards PEVs. It assumes lower battery/vehicle prices, higher range, and PEV availability across more vehicle classes.
- **BOOKEND:** Has the greatest amount of input from the utility stakeholders that participated in and offered input in the Demand Analysis Working Group, and staff anticipates the results to show the book end for expansion of PEVs. This scenario represents a set of inputs that would require a disruptive pricing strategy by manufacturers for PEVs while meeting consumer expectations on PEV price parity with ICE vehicles, in all PEV classes. This scenario also assumes increasing consumer preferences toward PEVs.



Proposed PEV Demand Scenarios

PEV Inputs	Low	Mid	High	Aggressive	Bookend
Availability of PEV Classes (in 2030)	PEV Models available in 11 out of 15 CEC light-duty classes	PEV Models available in 11 out of 15 CEC light-duty classes	PEV Models available in 11 out of 15 CEC light-duty classes	PEV Models available in 13 out of 15 CEC light-duty classes	PEV Models available in all CEC light-duty vehicle classes
PEV Preferences	Constant	Increase with Market Growth	Increase with Market Growth	Increase with Market Growth	Increase with Market Growth
Vehicle/Battery Price (by 2030)	PEV prices based on battery price declining to ~ \$120 / kWh	PEV prices based on battery price declining to ~ \$100 / kWh	PEV prices based on battery price declining to ~ \$89 / kWh	PEV prices based on battery price declining to ~ \$73 / kWh	PEV reach Price Parity with Gasoline vehicles by 2030
Federal Tax Credit	Decreasing starting in 2019	Decreasing starting in 2019	Decreasing starting in 2019	Through 2030	Through 2030
State Rebate	To 2020	To 2025	To 2025	To 2030	To 2030
HOV	To 2019	To 2025	To 2025	To 2025 for PHEV / 2030 for EV	To 2025 for PHEV / 2030 for EV
Avg. Range (2030)*	~ 230 miles	~ 230 miles	~ 270 miles	~ 270 miles	~ 270 miles
Refuel Time (2030)	15 - 21 min	15 - 21 min	10 - 16 min	10 - 16 min	Same as Gasoline
Time to Stn. (2030)	7 - 8 min	Same as Gasoline (5 min)	Same as Gasoline (5 min)	Same as Gasoline by 2030	Same as Gasoline by 2025



PEV Stock in 2030 (NOT FINALIZED)

- Low: 2.4 million to 2.6 million
- Mid: 3.1 million to 3.3 million
- High: 3.5 million to 3.8 million
- Aggressive: 5.0 million to 5.3 million
- Bookend: 5.5 million to 5.8 million

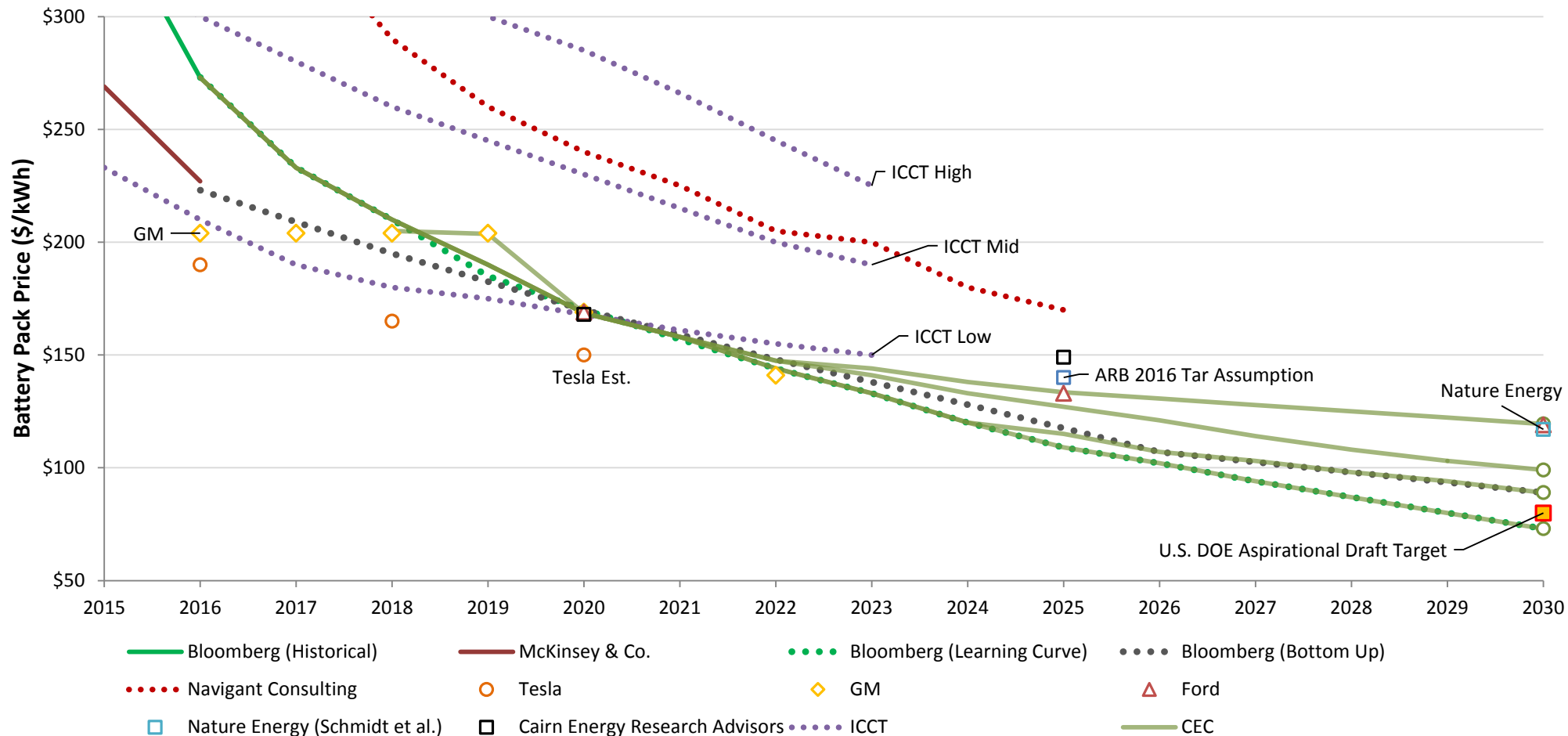


THANK YOU



Forecasts of Battery Costs

Battery Pack Costs (\$/kWh)





BEV Prices vs Gasoline Vehicles

- BEV prices shown in relation to gasoline vehicle prices
 - Prices are average for entire vehicle class
 - “Compact car”, “Mid-size car”, “ Small crossover (truck)” are best-selling
 - Low volume: Higher share of luxury vehicles for large and sports car classes for BEVs → higher BEV prices

SELECT VEHICLE CLASSES	BEV vs. GASOLINE VEHICLE PRICES in 2030				
	LOW	MID	HIGH	AGGR	BOOKEND
Car-Compact	16%	9%	9%	4%	0%
Car-Midsize	6%	3%	4%	0%	0%
Crossover - Small	15%	10%	10%	5%	0%
Crossover - Midsize	6%	2%	2%	-3%	-3%
SUV - Compact	10%	8%	4%	-1%	-1%
SUV - Midsize	10%	5%	5%	1%	0%

NOTES:
High, Aggressive, Bookend cases
have longer BEV range.



LDV Introduction Matrix Preliminary – All Cases

	Class	Gasoline	Hybrid	PHEV	EV	FCV	Diesel	FFV
1	Subcompact						2017	
2	Compact					Mirai		
3	Midsize					Clarity (2017)		
4	Large						2017	
5	Sport		2017		2020		2015	2015
6	Crossover - Small Car			2019	2016			
7	Crossover - Small Truck						2015	
8	Crossover - Mid			2019			2016	
9	Sports Utility - Compact			2020	2019		2017	
10	Sports Utility - Midsize							
11A	Sports Utility - Large							
12	Van Compact		2019	2017				
13A	Van - Large							
14	Pickup - Compact		2020			2023	2016	
15A	Pickup - Standard		2017					

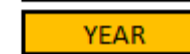
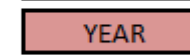
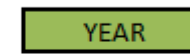
Exists 2015 - 2030

Introduced

Eliminated

Never Introduced

Introduced in Revised Forecast





LDV Introduction Matrix

Revised –
LOW/MID/HIGH

	Class	Gasoline	Hybrid	PHEV	EV	FCV	Diesel	FFV	PHFCV
1	Subcompact						2017		
2	Compact					Mirai			
3	Midsize					Clarity (2017)			
4	Large						2017		
5	Sport		2017		2020		2015	2015	
6	Crossover - Small Car			2018	2016				
7	Crossover - Small Truck						2015		
8	Crossover - Midsize			2016	2019		2016		2019
9	Sports Utility - Compact			2019	2020	2020	2017		
10	Sports Utility - Midsize			2016	2019				
11A	Sports Utility - Large		2019						
12	Van - Compact		2019	2017	2022	2022			
13A	Van - Large			2020					
14	Pickup - Compact		2020	2019		2023	2016		
15A	Pickup - Standard		2017						

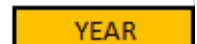
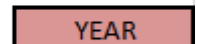
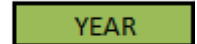
Exists 2015 - 2030

Introduced

Eliminated

Never Introduced

Introduced in Revised Forecast





LDV Introduction Matrix Revised - AGGRESSIVE

	Class	Gasoline	Hybrid	PHEV	EV	FCV	Diesel	FFV	PHFCV
1	Subcompact						2017		
2	Compact					Mirai			
3	Midsize					Clarity (2017)			
4	Large						2017		
5	Sport		2017		2020		2015	2015	
6	Crossover - Small Car			2018	2016				
7	Crossover - Small Truck						2015		
8	Crossover - Midsize			2016	2019		2016		2019
9	Sports Utility - Compact			2019	2020	2020	2017		
10	Sports Utility - Midsize			2016	2019				
11A	Sports Utility - Large		2019						
12	Van - Compact		2019	2017	2022	2022			
13A	Van - Large			2020	2022				
14	Pickup - Compact		2020	2019		2023	2016		
15A	Pickup - Standard		2017		2023				

Exists 2015 - 2030

Introduced

Eliminated

Never Introduced

Introduced in Revised Forecast

