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<th><strong>Docket Number:</strong></th>
<th>17-IEPR-05</th>
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<tr>
<td><strong>Project Title:</strong></td>
<td>Transportation Energy Demand Forecast</td>
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<td><strong>TN #:</strong></td>
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<tr>
<td><strong>Document Title:</strong></td>
<td>Transportation Energy Demand Forecast, 2017-2030</td>
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<tr>
<td><strong>Description:</strong></td>
<td>6.20.17: Transportation Energy Demand Forecast, 2017-2030. Presentation by: Siva Gunda, Jesse Gage, Mark Palmere, Sudhakar Konala</td>
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<td><strong>Filer:</strong></td>
<td>Raquel Kravitz</td>
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<td><strong>Organization:</strong></td>
<td>California Energy Commission</td>
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<tr>
<td><strong>Submitter Role:</strong></td>
<td>Commission Staff</td>
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<td><strong>Submission Date:</strong></td>
<td>6/16/2017 8:04:42 AM</td>
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<td><strong>Docketed Date:</strong></td>
<td>6/16/2017</td>
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Transportation Energy Demand Forecast, 2017-2030

IEPR Commissioner Workshop on the Preliminary Transportation Energy Demand Forecast

June 20, 2017
Transportation Energy Forecasting Unit
Demand Analysis Office
Energy Assessments Division
Transportation Forecast Schedule
(Dates to be added before workshop)

- Public comments
- Transportation energy supply workshop
- Electricity demand forecast workshop
- Natural gas outlook workshop
- Revised transportation forecast
- Staff report
Key Takeaways

- Declining gasoline demand
- Increasing alternate fuel vehicles
- Increasing electrification of vehicles, especially light-duty vehicles
California Energy Commission

Transportation Models
Key Inputs & Outputs

- Economic/Demographic Forecasts & Other Data
- 2015 Vehicle Population (from California DMV)
- Crude Oil Price Forecast (from U.S. EIA)
- Regulations
  Corporate Avg. Fuel Economy
  California ZEV Program
- Vehicle Attributes (forecast)
- 2016 California Vehicle Survey
- CA Transportation Energy Price Forecasts
- Transportation Energy Demand Models
- Transportation Energy Demand
- California Vehicle Population (forecast)
Components of Fuel Demand Section

• Transportation Demand Cases
• Fuel Costs
  – Crude Energy Price
  – Energy Costs and Costs per Mile
  – Trends in Fuel Prices
• Fuel Demand
  – Conventional Fuels (Gasoline, Diesel, Jet Fuel)
  – Alternative Fuels (Electricity, Natural Gas, Hydrogen, E85)
  – High-Speed Rail
Transportation Demand Cases

Cases represent different levels of transportation electricity demand

- **Transportation Demand Cases**
  - High Electricity Demand (High Case)
    - Inputs selected to represent high level of electricity demand
  - Mid Electricity Demand (Mid Case)
  - Low Electricity Demand (Low Case)
    - Inputs selected to represent low level of electricity demand

- **Inputs**
  - Income, population, fuel prices
Oil Prices Remain Low in the Near Term
Historical and Projected Brent Crude Oil Prices

Note: Spot prices are in nominal dollars per barrel; projections are in 2015 dollars per barrel.

Source: Energy Information Administration (Historical), California Energy Commission (Projected)
Trends in Fuel Prices

- For Light Duty Vehicles
  - Electricity is projected to have the lowest cost per mile among fuel types
  - Hydrogen fuel costs are projected to decrease over the forecast period

- For Medium Duty Trucks
  - Electricity fuel cost per mile remains relatively flat and offers the lowest cost per mile among fuel types

- For Medium Heavy Duty Trucks
  - Diesel-Electric Hybrid is the fuel type with the lowest cost per mile
  - Natural gas has marginal fuel cost advantage over diesel
California Energy Commission

Fuel Cost per Mile Trends in Medium Duty (GVWR 4 to 6) Trucks
Mid Case

Source: California Energy Commission
California Energy Commission

Fuel Cost per Mile Trends
All New Light-Heavy (GVWR 7) and Straight Heavy-Heavy (GVWR 8) Duty, Mid Case

Source: California Energy Commission
Projected Alternative Fuel Consumption
Mid Case, All Vehicles and Modes

Source: California Energy Commission
Projected High-Speed Rail Electricity Consumption

Source: California High-Speed Rail Authority
VEHICLE SALES FORECAST
Components of Vehicle Stock Section

• Inputs
  – Economic and Demographic Data
  – Vehicle Attributes
  – Consumer Preferences

• Outputs
  – Light-Duty Stock and Fuel Economy Forecasts
  – Medium- and Heavy-Duty Stock Forecast

• Takeaways
Light-Duty Vehicle Population Grows with Population and Economy

Source: California Energy Commission
Transportation Models
Key Inputs & Outputs

- Economic/Demographic Forecasts & Other Data
- 2015 Vehicle Population (from California DMV)
- CA Transportation Energy Price Forecasts
- Crude Oil Price Forecast (from U.S. EIA)
- Regulations
  Corporate Avg. Fuel Economy California ZEV Program
- Vehicle Attributes (forecast)
- 2016 California Vehicle Survey

Transportation Energy Demand Models

Transportation Energy Demand
California Vehicle Population (forecast)
Vehicle Attributes Inform CEC Forecasts of New Vehicle Sales

- Attributes used in “vehicle choice” decisions
- Account for regulatory requirements
- Base year and projections through 2030
- Light-duty vehicle attributes
  - Range
  - Retail Price
  - Fuel Economy
  - Acceleration
  - # of Makes / Models
  - Refueling Time
  - Maintenance Costs
  - Cargo Capacity
## Consumer Attribute Preference Changes Since 2013

(Based on California Vehicle Surveys 2013 & 2016 Conducted by CEC)

<table>
<thead>
<tr>
<th>Residential</th>
<th>Commercial</th>
</tr>
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<tbody>
<tr>
<td>Lower preference for vehicle price</td>
<td>Vehicle price continues as most significant attribute</td>
</tr>
<tr>
<td>Higher preference for vehicle range</td>
<td>Higher preference for vehicle range</td>
</tr>
<tr>
<td>Higher preferences for tax credit and rebate; lower for HOV lane access</td>
<td>HOV lane and Tax credits both significant</td>
</tr>
<tr>
<td>Lower preference for fuel economy</td>
<td>Lower preference for fuel economy</td>
</tr>
<tr>
<td></td>
<td>Higher preference for acceleration</td>
</tr>
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</table>
Alternative Fuel Vehicle Share of Light-Duty Market Increases Throughout Forecast

Light-Duty Vehicle Population Share by Fuel Type, Mid Case

- Electric
- Hydrogen
- Plug-in Hybrid
- Hybrid
- Diesel
- Gasoline (Including Flex-fuel)

Source: California Energy Commission
Closer Look at Alternative Fuel Vehicle Share of Light-Duty Vehicle Population Share by Fuel Type, Mid Case
ZEVs Increase New Vehicle Sales Share with Price/Range Competitiveness

Light-Duty Vehicle Sales by Fuel Type, Mid Case

Source: California Energy Commission
California Energy Commission

Closer Look at ZEV New Vehicle Sales Share Throughout Forecast
Light-Duty Vehicle Sales by Fuel Type, Mid Case

Share of New Vehicle Sales

- Electric
- Hydrogen
- Plug-in Hybrid
- Hybrid
- Diesel
- Gasoline (Including Flex-fuel)

Source: California Energy Commission
California Energy Commission

Fuel Economy of New Light-Duty Vehicles Increases
Sales-weighted Average Light-Duty Vehicle Fuel Economy, All Fuel Types

Source: United States Environmental Protection Agency, California Energy Commission
Alternative Fuel Truck Share Increases
New Medium Duty (GVWR 4 to 6) Truck Sales by Fuel Type, Mid Case

Source: California Energy Commission
Alternative Fuel Truck Share Increases
New Light-Heavy (GVWR 7) and Straight Heavy-Heavy (GVWR 8) Duty Truck Sales
Mid Case

Source: California Energy Commission
ZEV ANALYSIS
Battery Electric Vehicle Range is Forecasted to Grow

- Large swings in range (up or down) are due to introduction of new models.

Source: California Energy Commission
Projected Average Fleet wide BEV Range

Source: California Air Resources Board, California Energy Commission
BEV Prices Decline Over Time
BEV Sales Price, by Class

Prices increase due to introduction of longer range models.
Prices decrease as battery costs decline.

Source: California Energy Commission
ZEV On-road Vehicle Stock Continues to Grow
Cumulative ZEV and PHEV Population

<table>
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<tr>
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<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
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<tr>
<td>CEC (Mid Case)</td>
<td>171,601</td>
<td>~715,000</td>
<td>~1.4 Million</td>
<td>2.0+ Million</td>
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Source: California Air Resources Board, California Energy Commission
Growth Potential for FCEVs
Fuel Cell Vehicles 2017-2030, Mid Case

Source: California Air Resources Board, California Energy Commission
Meeting the ZEV Regulation

• CEC’s Transportation Demand Forecast assesses market demand for ZEVs, and generates a forecast of sales

• By converting forecast of ZEV sales to ZEV credits, staff can check the forecast results for compliance with ARB’s ZEV regulations

• Result: Forecast projects compliance in all cases
Residential Charging Primarily Occurs at Home and Overnight

Source: 2016 California Vehicle Survey, conducted by the California Energy Commission
Next Steps

• Incorporate:
  – Stakeholder feedback
  – Updated economic forecast
  – Revised light, medium and heavy-duty vehicle attributes
  – Consider time of use electricity rate forecast

• Generate revised forecast
Thank You

- For further questions please contact:
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    - Mark.Palmere@energy.ca.gov