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PEV Charging Load Shape Forecast Updates & Exploratory Scenario Load Shapes

Alex Lonsdale

Date: December 3, 2020

Presentation Outline

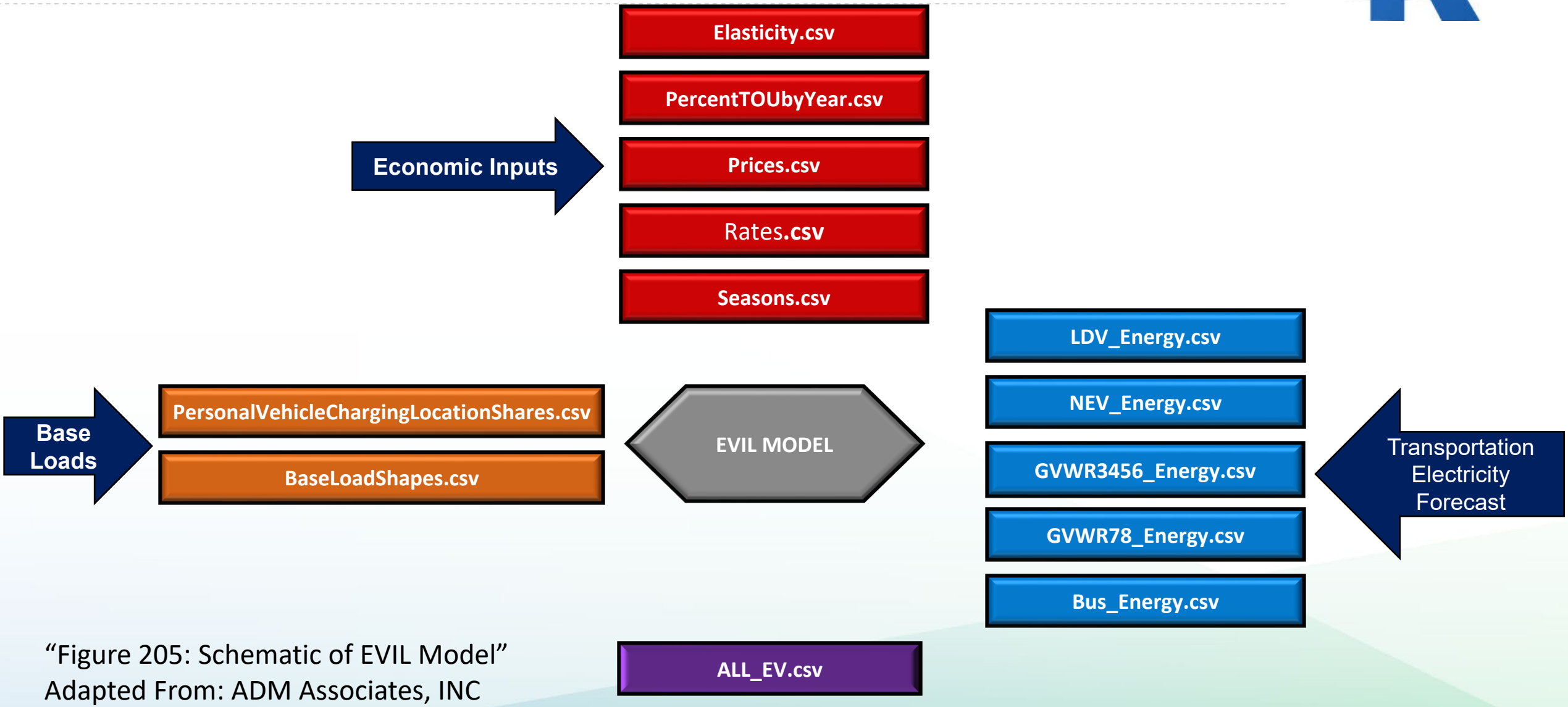
- EV Infrastructure Load Model Overview
- Load Shape Forecast Updates
  - Model Inputs
  - Load Shape Comparisons
- Exploratory Scenarios
  - GHG Scenario
  - Worst Case Scenario
  - Key Takeaways

EV Infrastructure Load Model Overview

Background

- The Electric Vehicle Infrastructure Load Model was constructed by ADM Associates to integrate PEV Charging Load Shapes into the hourly California Energy Demand Forecast.
- A top-down model that disaggregates the annual transportation electricity demand forecast according to observed or assumed charging behavior.
- The model simulates how residential and commercial sectors may respond to time of use rates.

Model Schematic



"Figure 205: Schematic of EVIL Model"
Adapted From: ADM Associates, INC

Modeling Demand Shift

- Economic Inputs shift the base load shape for each forecast zone.
- Residential adjustment factors are determined as follows:
- Commercial adjustment factors do not include TOU% variable.

$$A_h = \max\left(0, 1 + TOU\% \times e \times (PR_h - 1)\right)$$

Where:

- A_h is the adjustment factor for hour h
- TOU% is the percentage of customers that have a TOU rate
- PR_h is the price ratio for hour h, defined as the price prevailing at hour h divided by the lowest available price for the given day, at the same location
- e is the Elasticity Factor

Source: ADM Associates, INC

PEV Charging Load Shape Forecast Updates

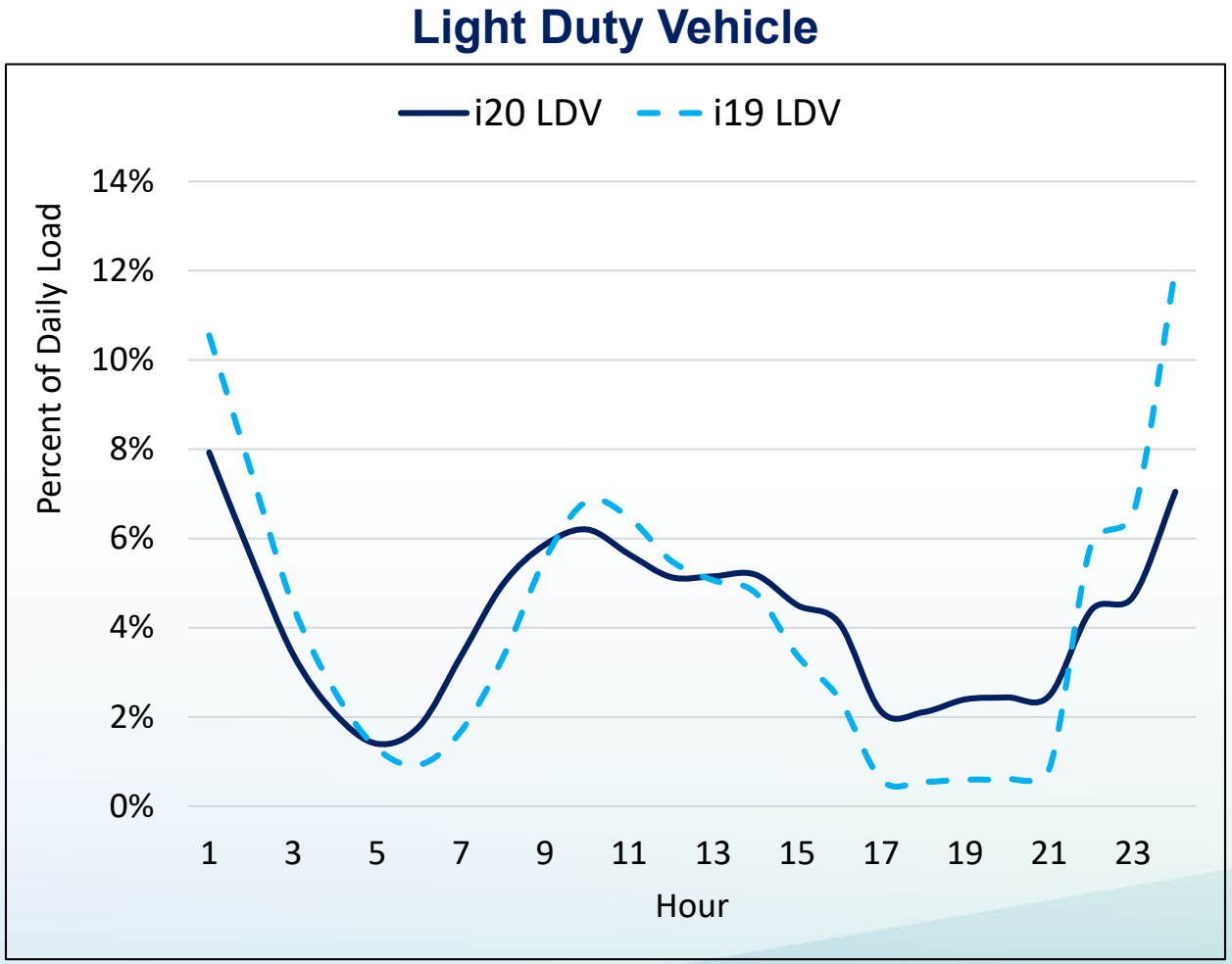
Model Input Updates

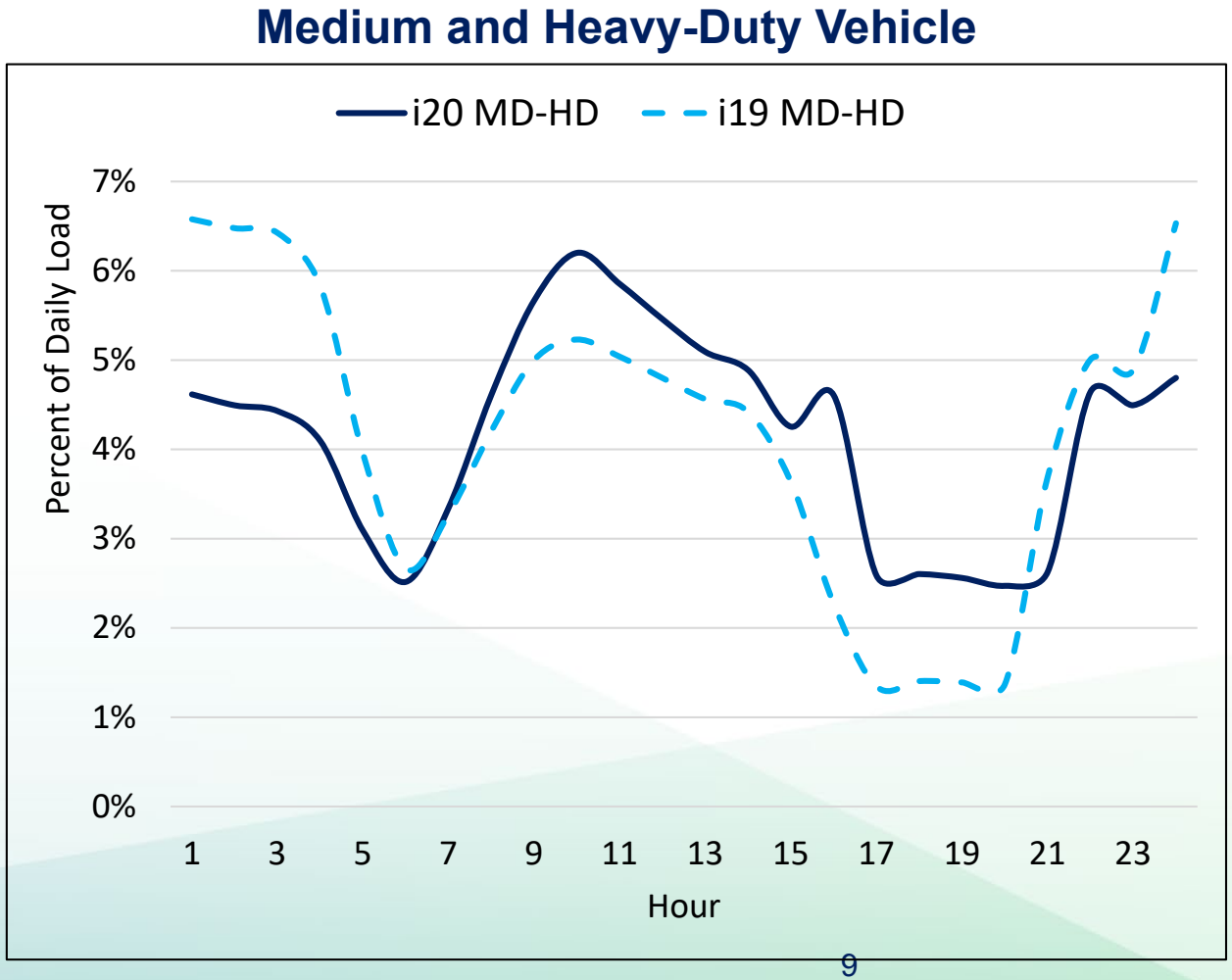
The following updates apply to the Low, Mid, and High cases:

- Residential TOU participation forecast
  - Increase in expected TOU rate participation
- TOU rates
  - Reflects current pricing and period structures for each IOU
- Decreased price plasticity of demand for commercial and residential sectors
- Personal Vehicle Destination Load Shape
  - Uses EVI-Pro load shape
- Personal Vehicle Charging Location Shares
  - Aligns with EVI-Pro

PG&E Load Shapes

- The following mid-case load shapes for an average summer weekday in 2030.



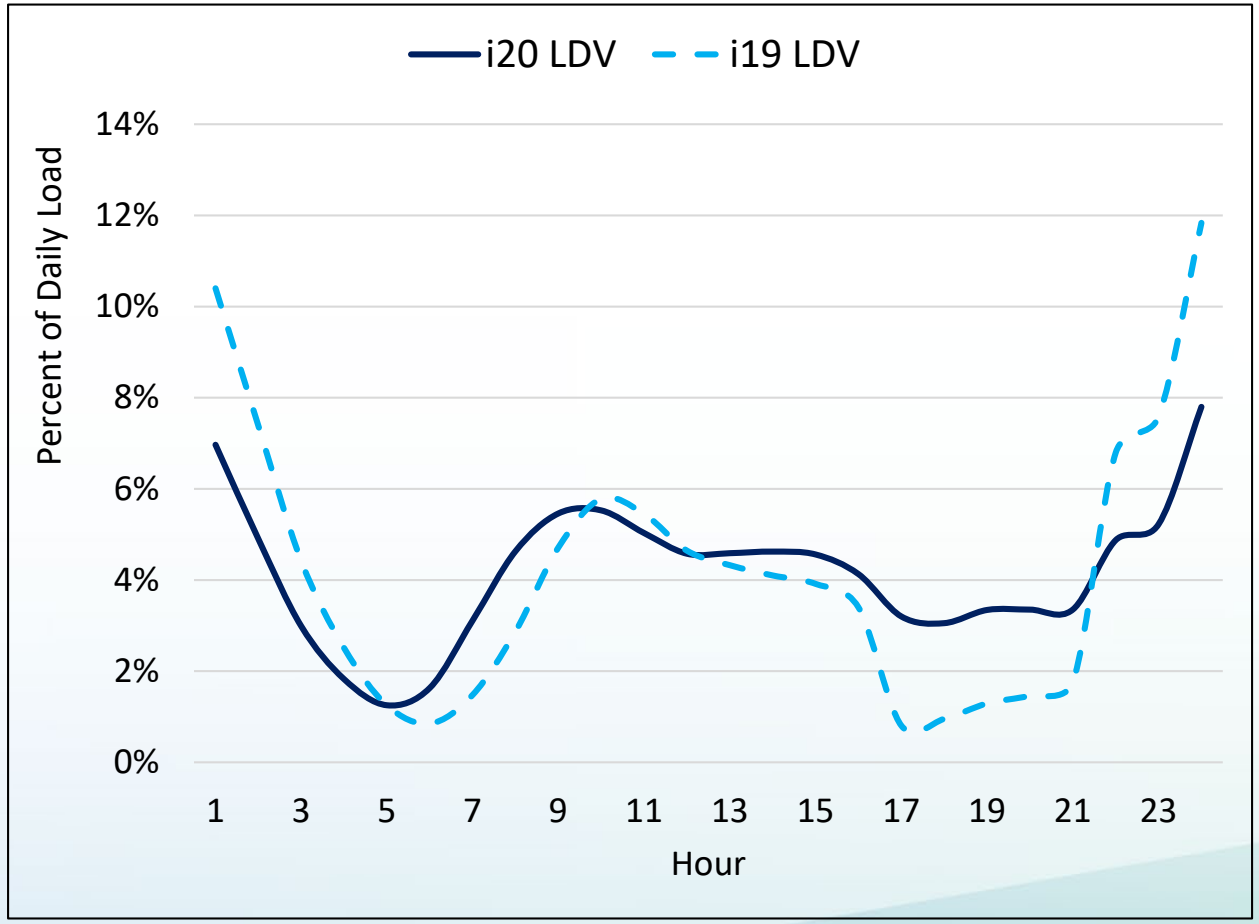


Source: CEC Staff

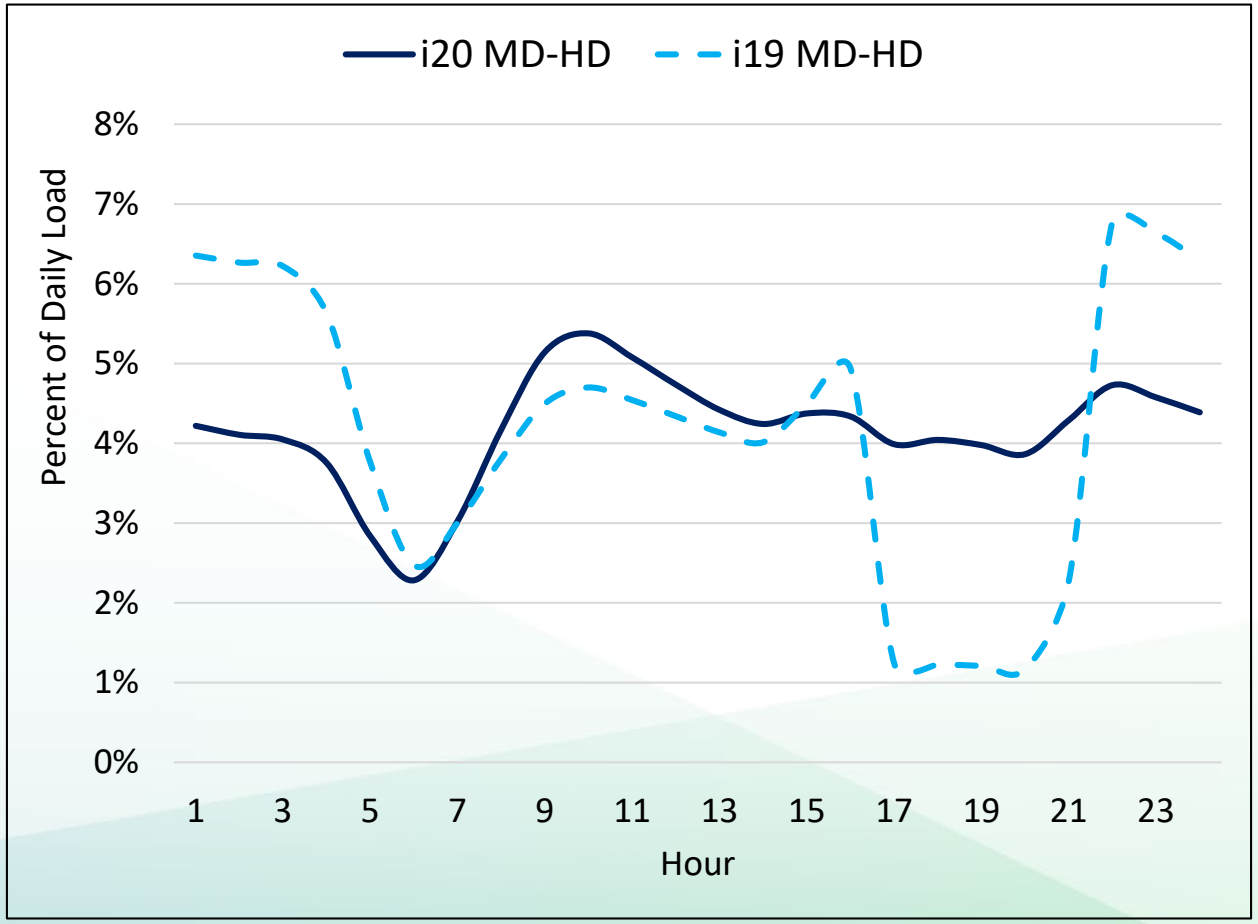
SCE Load Shapes

- The following mid-case load shapes for an average summer weekday in 2030.

Light Duty Vehicle



Medium and Heavy-Duty Vehicle

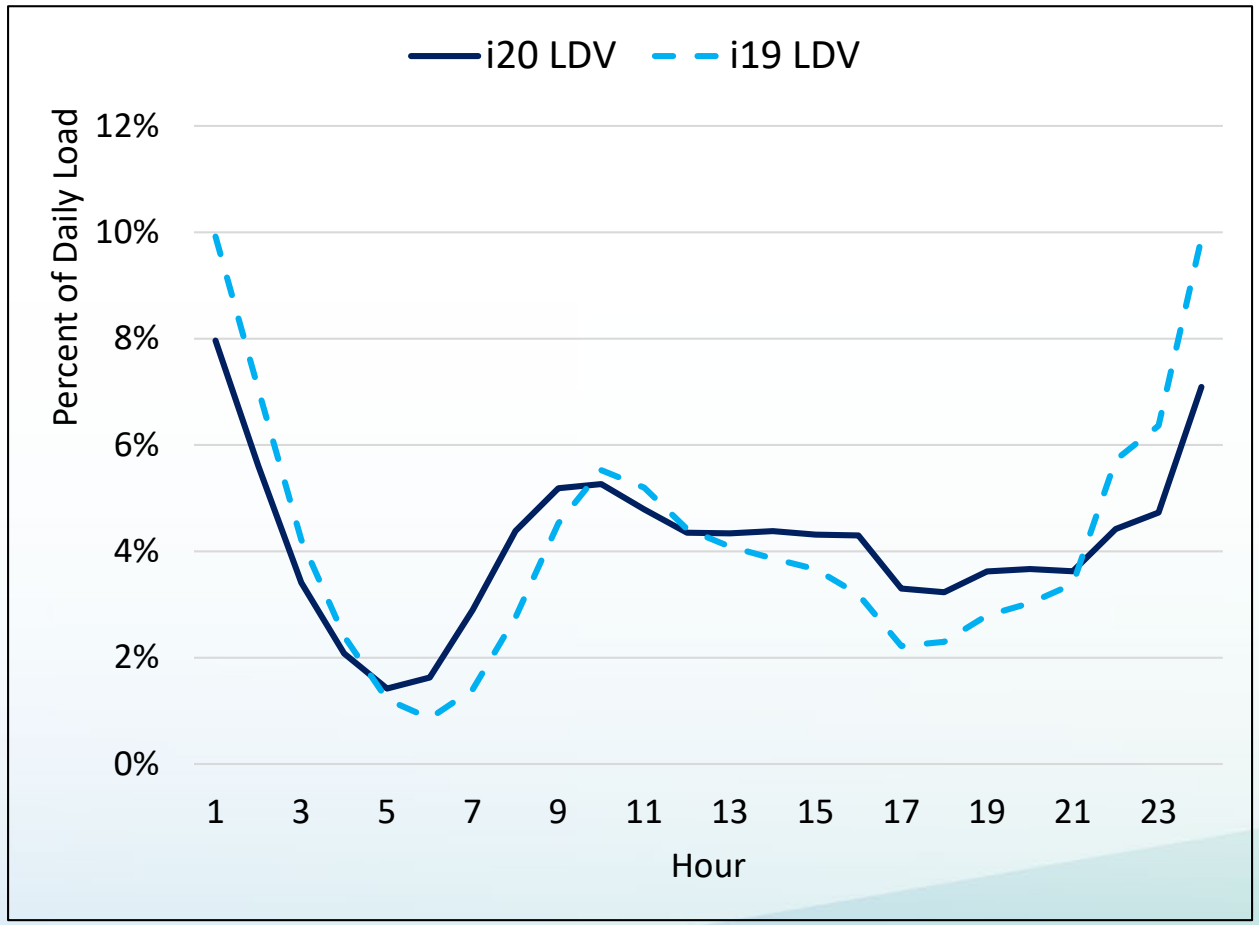


Source: CEC Staff

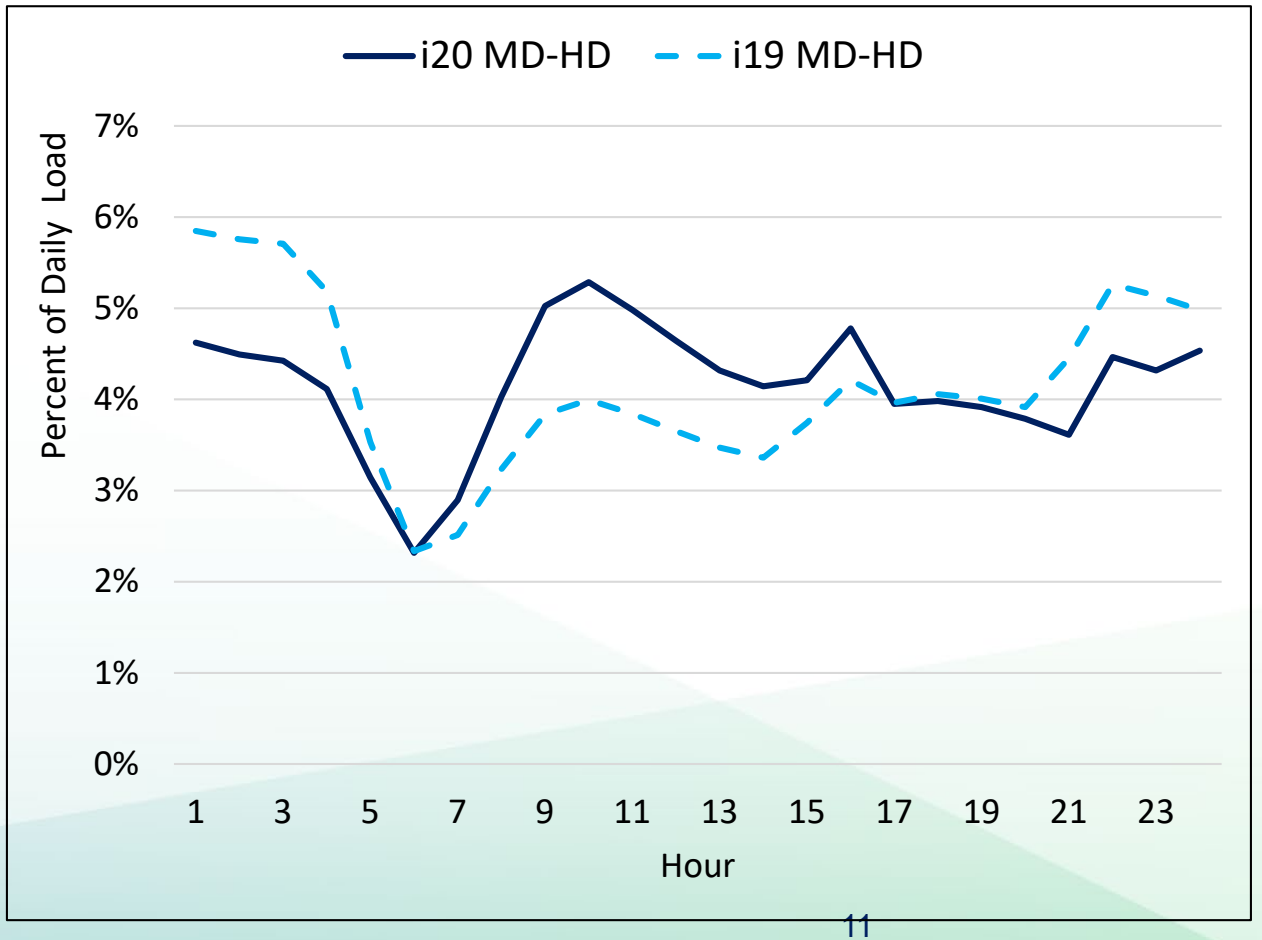
SDG&E Load Shapes

- The following mid-case load shapes for an average summer weekday in 2030.

Light Duty Vehicle



Medium and Heavy-Duty Vehicle



Source: CEC Staff

Exploratory Scenarios: PEV Charging Load Shapes

EV Charging Load Shape Scenarios

- What-if scenarios, developed in addition to the low, mid, and high case forecasts
- Intended to estimate impacts of proposed programs or policies or explore other relevant questions that are outside the scope of the adopted forecast
- These scenarios were developed outside of the EV Infrastructure Load Model, and are not dependent on time-of-use rates
- **GHG Scenario** explores the statewide impact on the grid if EV charging was managed to minimize GHG emissions
- **Worst Case scenarios** explores the impact on the CAISO system if the majority of EV charging occurs during peak hours

GHG Scenario

GHG Scenario: Emission Factors

Mid-Case 2030 California System Average Grid CO_2 Emission Intensity Factors (Metric Ton CO_2/MW)

HOURS

Month

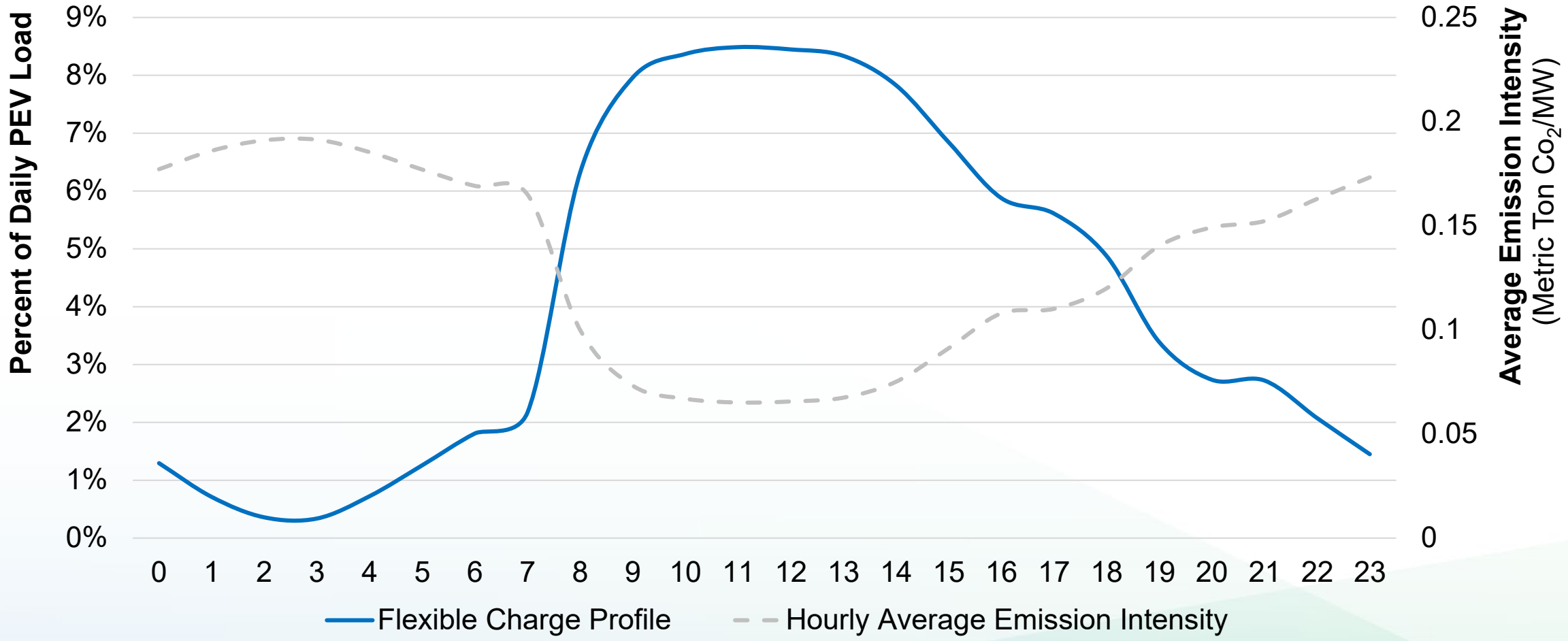
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	0.191	0.200	0.205	0.206	0.203	0.192	0.175	0.174	0.134	0.083	0.066	0.061	0.060	0.066	0.076	0.143	0.171	0.148	0.144	0.148	0.154	0.163	0.176	0.184
2	0.165	0.173	0.178	0.178	0.174	0.164	0.147	0.143	0.092	0.049	0.042	0.040	0.041	0.041	0.046	0.070	0.147	0.132	0.123	0.126	0.132	0.139	0.151	0.157
3	0.145	0.149	0.153	0.153	0.145	0.133	0.126	0.136	0.075	0.044	0.039	0.038	0.038	0.038	0.039	0.043	0.082	0.116	0.102	0.105	0.113	0.123	0.132	0.139
4	0.109	0.112	0.114	0.112	0.106	0.099	0.096	0.098	0.047	0.038	0.035	0.035	0.035	0.035	0.036	0.038	0.046	0.080	0.072	0.087	0.085	0.089	0.098	0.105
5	0.091	0.097	0.098	0.096	0.092	0.087	0.083	0.079	0.040	0.036	0.035	0.035	0.036	0.034	0.034	0.037	0.045	0.057	0.059	0.086	0.085	0.077	0.080	0.085
6	0.097	0.098	0.102	0.103	0.103	0.101	0.091	0.073	0.043	0.037	0.036	0.035	0.035	0.035	0.036	0.039	0.044	0.055	0.066	0.095	0.109	0.095	0.093	0.099
7	0.163	0.173	0.178	0.179	0.175	0.171	0.163	0.146	0.086	0.066	0.062	0.060	0.060	0.061	0.067	0.079	0.096	0.104	0.111	0.131	0.138	0.138	0.151	0.161
8	0.209	0.219	0.225	0.227	0.221	0.213	0.207	0.197	0.101	0.075	0.068	0.067	0.068	0.071	0.078	0.094	0.124	0.127	0.131	0.144	0.149	0.163	0.183	0.196
9	0.221	0.230	0.233	0.233	0.227	0.216	0.211	0.212	0.119	0.079	0.071	0.068	0.068	0.071	0.081	0.107	0.144	0.140	0.147	0.159	0.172	0.188	0.198	0.208
10	0.213	0.219	0.222	0.221	0.215	0.200	0.191	0.201	0.124	0.068	0.057	0.054	0.054	0.056	0.063	0.096	0.149	0.135	0.141	0.152	0.165	0.180	0.190	0.201
11	0.195	0.203	0.208	0.208	0.205	0.195	0.181	0.177	0.101	0.064	0.058	0.057	0.058	0.063	0.080	0.151	0.162	0.143	0.145	0.151	0.158	0.169	0.181	0.188
12	0.215	0.222	0.225	0.226	0.224	0.216	0.200	0.199	0.142	0.088	0.076	0.070	0.071	0.079	0.095	0.177	0.182	0.161	0.160	0.165	0.172	0.182	0.196	0.206

Source: CEC Staff

GHG Scenario: Flexible Vehicle Categories

Assumed Flexibility	EV Infrastructure Load Model Vehicle Category
Flexible	Personal LDV (Single Family, Multi Family), Personal LDV (Destination), Commercial LDV, Neighborhood EV, School Buses
Inflexible	Government/Rental LDV; Gross Vehicle Weight Rating (GVWR) classes 3, 4, 5, and 6; GVWR classes 7 and 8; Urban Buses

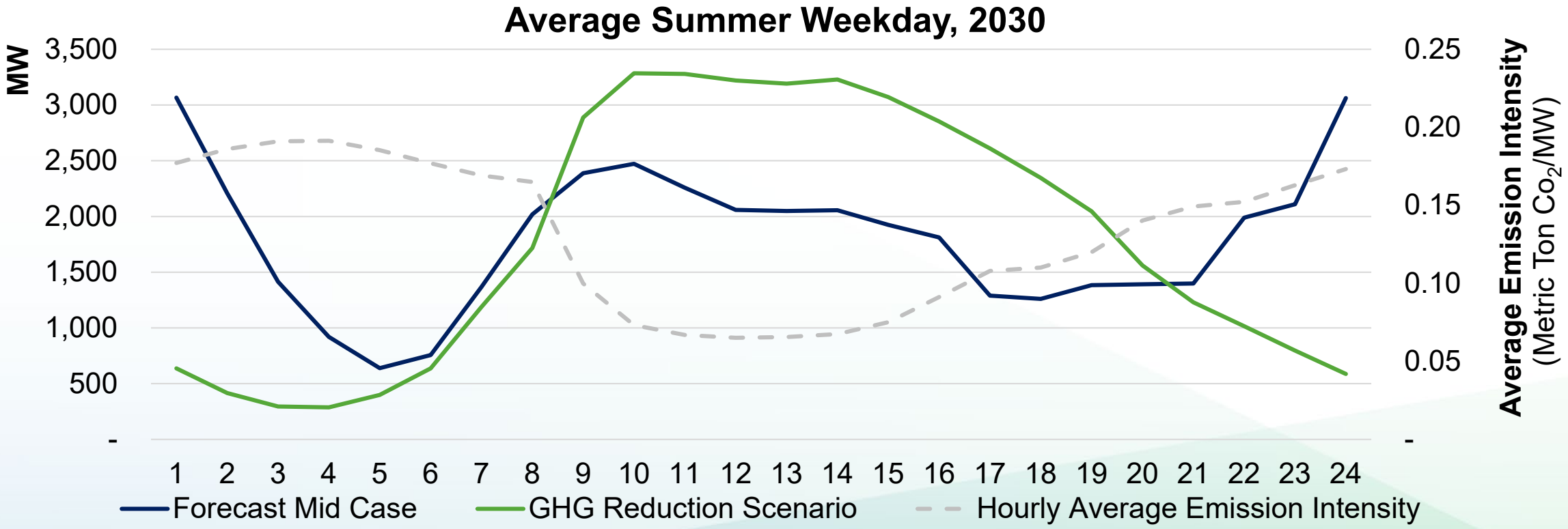
GHG Scenario: Flexible Summer Weekday Load Profile 2030



Source: CEC Staff

GHG Scenario Results - Statewide

Measure	Forecast Mid Case	GHG Reduction Scenario
System Peak Contribution (MW)	1,384	2,046
Annual GHG Emissions (Metric Ton CO2) *From Charging	1,672,800	1,292,176

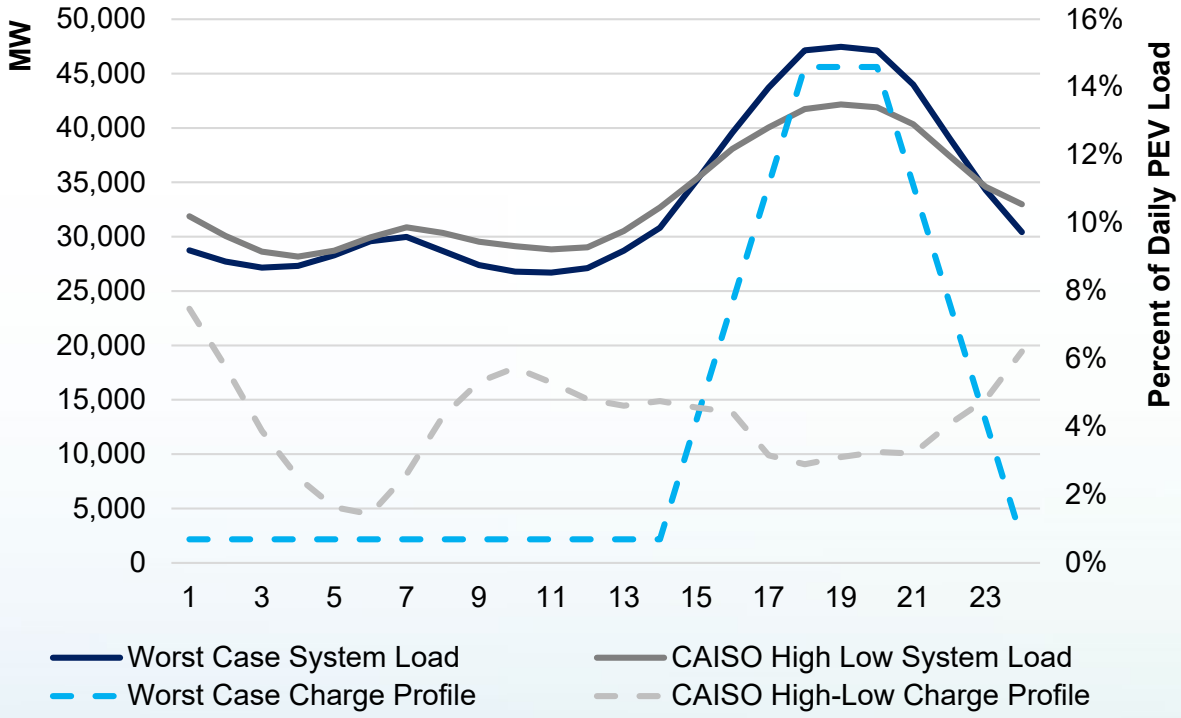


Source: CEC Staff

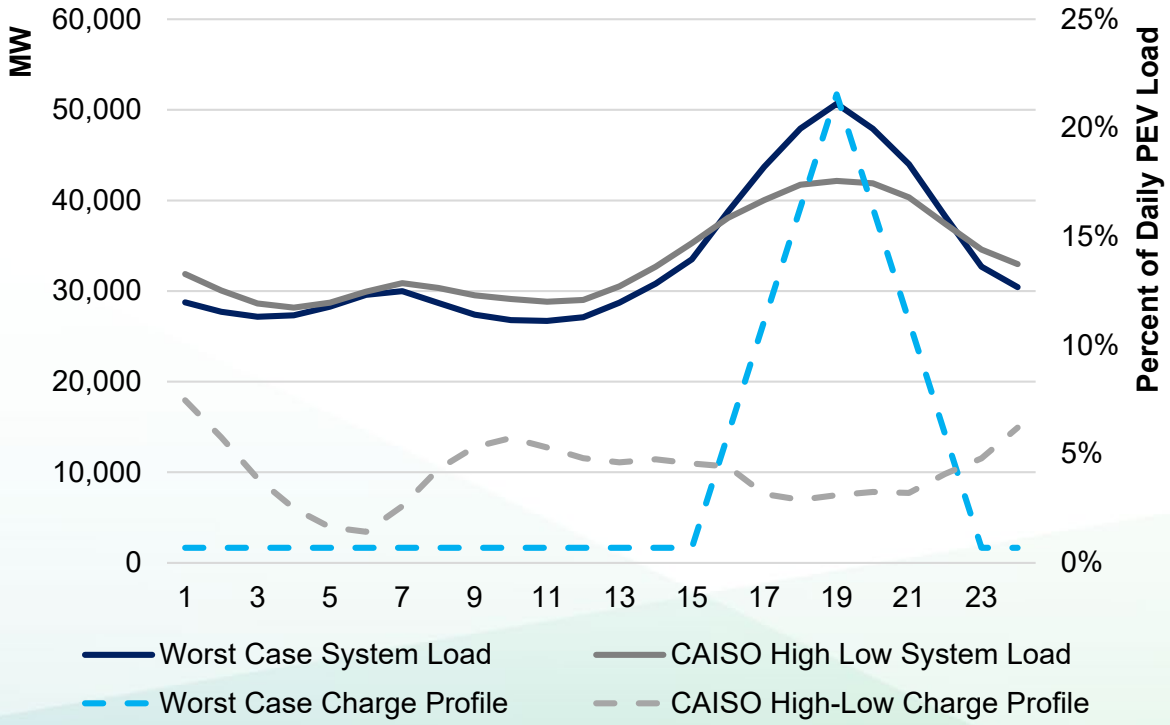
Worst Case

Worst Case Results

Profile 1: Increases the forecasted peak load by 5,295 MW in 2030



Profile 2: Increases the forecasted peak load by 8,501 MW in 2030



Note: CAISO High-Low Charge Profiles are from the 2019 IEPR

Key Take-Aways

- These scenarios highlight the importance of TOU rates or other strategies to discourage PEV owners from charging during the peak system hours.
- When developing load shifting strategies to address climate change, it is important to consider both the grid conditions and GHG emission intensity factors.

Thank You!

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Link to ADM's complete documentation for the EV Infrastructure Load model, located in Chapter 10:
https://ww2.energy.ca.gov/2019publications/CEC-500-2019-046/CEC-500-2019-046.pdf