EV Revenue Forecast for Public Service's 2021-2023 TEP Retail Rate Impact Calculation

Pursuant to Commission Decision No. C21-0017 in Proceeding No. 20A-0204E, Public Service presents this description of how Public Service will estimate the electric vehicle ("EV") revenues to be included in the retail rate impact cap calculation required for its 2021-2023 TEP as required by C.R.S. § 40-1-103.3(6).

Incremental EV Revenue Forecast

Public Service has developed a forecast of the number of EVs expected to be adopted in Colorado and the associated energy consumption. To develop assumptions regarding the timing of charging and the applicable rate schedule, the Company utilized the result of the Markov-Chain Monte Carlo analysis performed by Energy+Environmental Economics (E3) for the Company's 2020 TEP. The estimated number of EVs in 2020 was used as a baseline and revenue was calculated only for incremental EVs above that baseline.

Incremental EV Revenue Forecast

	2021	2022	2023
# of Evs	10,836	30,879	68,789
Energy Usage	42,889 MWh	107,980 MWh	230,891 MWh
Revenue	$7,327,252	$19,791,181	$43,961,204

EV Growth & Energy Use

For light duty vehicles, the Company forecasts EV adoption using two modeling techniques: 1) Bass Technology Diffusion and 2) Economic models. After establishing forecasts through both methods, the Company averaged the results to estimate EV adoption.

- *Bass Diffusion Modeling.* Bass Diffusion models are used to describe technology adoption patterns in an existing market through an "S" shaped diffusion characteristic. The Bass Diffusion model approach is calibrated using Colorado-specific historical EV sales, obtained from third-party consultant IHS Markit. The base case uses Colorado EV data while the high and low scenarios for the Bass Diffusion models are created using data from states that reflect high historical adoption rates for the high scenario, and low historical adoption rates for the low scenario.

- *Economic Modeling.* Economic models use a simple payback analysis to estimate the potential adoption, incorporating factors such as battery prices, tax incentives, fuel savings and others. Public Service created high and low adoption scenarios that were developed around the base scenario, using assumptions of varying battery costs and gasoline prices. The high adoption scenario assumes that battery prices are 20 percent lower than the base scenario, and gasoline prices are higher by one standard deviation. Conversely, the low adoption scenario assumes battery prices are 20 percent higher than the base scenario, and gasoline prices are lower by one standard deviation.

Additionally, the Company has incorporated into both the Bass diffusion and economic models a factor for the percentage of vehicles located in urban and rural areas. Presently higher adoption is occurring in urban areas with the rural areas of the service territory anticipated to ramp up more slowly. The estimates could fluctuate based on battery market dynamics as the cost for batteries is a significant factor in the overall cost of EVs. Additionally, the estimates are sensitive to exogenous variables that include policy, technology, manufacturing supply chain, geopolitical factors, and others.

Since Colorado is in the early stages of EV adoption, the nascent market brings significant uncertainties. The Company expects that as the market continues to grow and mature, future estimates will be increasingly robust as the Company continues to update our models with new data.

The Company utilizes the average annual miles driven and average kWh per mile to estimate the per vehicle annual consumption associated with the light duty vehicle forecast. The average annual miles driven is obtained from the Federal Highway Administration, and the average kWh per mile estimate is developed internally using data from a Department of Energy/Environmental Protection Agency website that provides fuel economy data. The medium and heavy-duty vehicle forecasted consumption utilizes an estimate produced by a third-party consultant (Navigant).

Incremental Growth in Light Duty EVs

	2021	**2022**	**2023**
# of Evs	10,834	30,873	68,745
Energy Usage	42,565 MWh	107,076 MWh	228,083 MWh
Average Usage	3,929kWh/yr	3,468kWh/yr	3,318kWh/yr

For medium and heavy-duty vehicles, the Company utilizes a medium duty vehicle (MDV) and heavy duty vehicle (HDV) forecast that was produced by a third party consultant (Navigant) for the Xcel Energy service territory in Colorado. The model uses a proprietary modeling framework known as VAST (Vehicle Adoption Simulation Tool) which is described as an enhanced systems dynamics innovation diffusion model. The Navigant model combines various aspects of an economic payback model that include inputs such as vehicle component prices, fuel and electricity prices, rebates/incentives, and battery pack prices. Navigant's proprietary model then estimates the long-run technology adoption potential based on vehicle availability, supply-side estimates of vehicle production, and applies an enhanced Bass diffusion methodology to generate its forecast.

The consumption and load estimates for MDV/HDVs are calculated by modeling the annual vehicle miles traveled (VMT) and weather-varying efficiency for each vehicle based on vehicle weight class and use cases. Navigant maintains load shapes for each use case/technology/vehicle type combination and are compiled from a variety of sources including: NREL EVIPro Model, Commercial fleet pilots, and others.

Incremental Growth in Medium & Heavy Duty EVs

	2021	**2022**	**2023**
# of Evs	2	5	44
Energy Usage	168 MWh	492 MWh	1,540 MWh
Average Usage	84,299kWh/yr	91,761kWh/yr	34,754kWh/yr

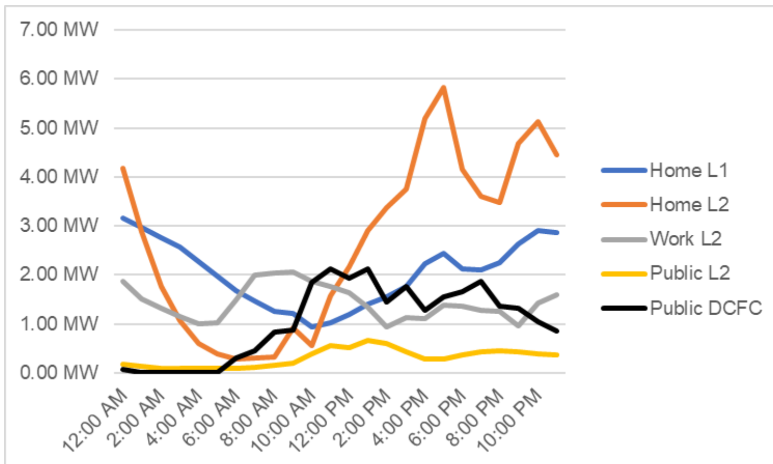
EV Charging Patterns

To estimate the revenues associated with incremental EV growth, it is first necessary to identify where and when EVs are likely to charge. For light duty vehicles, the Company utilized the Markov-Chain Monte Carlo simulation performed by E3. This analysis simulated driving and charging for thousands of EV drivers using travel survey data. The population is characterized by access to charging and different types of EVs. E3 modeled four personal light duty EVs and five charging access types (Home L1, Home L2, Work L2, Public L2, and Public DCFC). The result of the analysis was an estimated distribution of charging locations and annual load shapes for the five charging access types.

Distribution of LDV Charging

Home L1	30.8%
Home L2	35.4%
Work L2	18.2%
Public L2	13.0%
Public DCFC	2.6%

LDV Charging Patterns

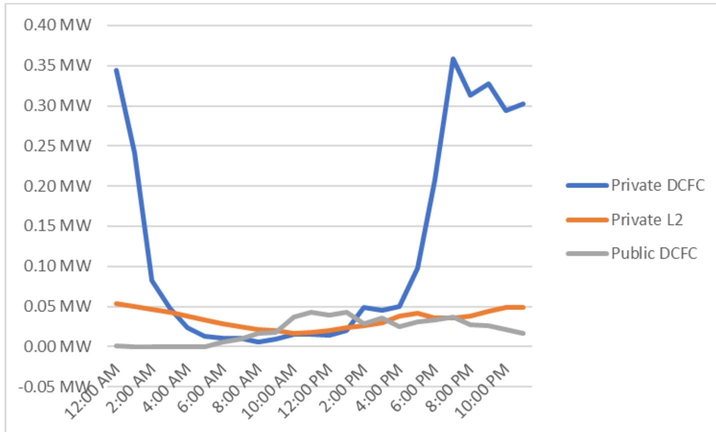


For medium and heavy-duty vehicles the Company again utilized the E3 analysis for daily charging patterns. However, the E3 analysis did not provide a distribution of charging across different sites. For medium-duty vehicles the Company assumed that 70 percent of charging would be at a private DCFC charging stations, 25 percent would be at private L2 charging stations, and the remaining 5 percent at public DCFC stations. For heavy-duty vehicles, such as buses, the Company assumes that 100 percent of charging occurred at dedicated DCFC charging stations.

Distribution of MDV & HDV Charging

	Medium Duty	Heavy Duty
Private DCFC	70%	100%
Private L2	25%	
Public DCFC	5%	

MDV & HDV Charging Patterns



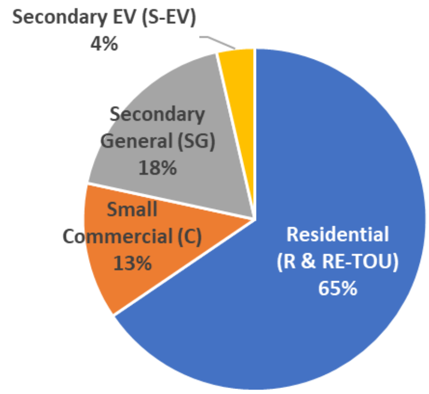
EV Revenue Forecast

The final step in forecasting incremental EV revenue is to apply Commission approved rates to the forecasted charging volumes. For this forecast the Company included the following rate Schedules: R, RE-TOU, C, SG, and S-EV. We used the rates, including riders, that were in effect as of March 23, 2021 and applied a simple 2 percent escalation to all charges. For personal light duty vehicles, a majority of charging occurs at home, split between the current Schedule R and RE-TOU which will become the default residential rate over the next five years. For charging at work, the Company assumed that most business would fall under Schedule SG. For public charging, most Level 2 charging equipment should utilize Schedule C as it is likely the most cost effective rate, and DCFC public charging is assumed to utilize Schedule S-EV. A majority of medium duty vehicles will have their own dedicated charging equipment at a business under Schedule SG or S-EV, but there will instances where those EVs will also utilize public DCFC charging under Schedule S-EV. Finally heavy duty vehicles, such as buses, will likely utilize privately owned charging facilities under Schedule S-EV.

Incremental EV Charging by Rate Schedule

	2021	2022	2023
Schedule R			
Tier 2	8,530 MWh	12,506 MWh	10,882 MWh
Tier 1	18,475 MWh	26,824 MWh	23,792 MWh
Schedule RE-TOU			
On-Peak	223 MWh	6,016 MWh	22,189 MWh
Shoulder	53 MWh	1,433 MWh	5,289 MWh
Off-Peak	892 MWh	24,087 MWh	88,830 MWh
Schedule C			
Summer	2,024 MWh	5,122 MWh	10,796 MWh
Winter	3,523 MWh	8,826 MWh	18,967 MWh
Schedule SG			
Demand	45,504 kW-mo	129,668 kW-mo	289,311 kW-mo
Energy	7,739 MWh	19,480 MWh	41,558 MWh
Schedule S-EV			
Demand	326,223 kW-mo	929,415 kW-mo	2,083,959 kW-mo
CPP	11 MWh	28 MWh	59 MWh
On-Peak	535 MWh	1,367 MWh	3,086 MWh
Off-Peak	883 MWh	2,290 MWh	5,442 MWh
Total	42,889 MWh	107,980 MWh	230,891 MWh

Total Incremental EV Load 2021-2023



Commission approved rates are applied against the estimated charging volumes to derive total revenues associated with new EVs purchased after 2020. The Company forecasts that incremental EV revenue will grow from about $7 million to almost $43 million in 2023.

LDV	2021	2022	2023
#	10,834	30,873	68,745
MWh	42,565	107,076	228,083
Revenue	$7,290,445	$19,687,121	$43,550,454
MDV			
#	-	-	28
MWh	-	-	469
Revenue	-	-	$125,240
HDV			
#	2	5	17
MWh	324	904	2,339
Revenue	$36,807	$104,060	$285,510
Total			
# of Evs	10,836	30,879	68,789
Energy Usage	42,889 MWh	107,980 MWh	230,891 MWh
Revenue	$7,327,252	$19,791,181	$43,961,204

The Company incorporated these updated EV revenue projections into its retail rate impact analysis and concludes that the impacts of our EV programs will still be well below the statutory cap of 0.5 percent.

Retail Rate Impact - April 1st 2021

		2021	2022	2023
	Revenue from EV Charging	($7,327,252)	($19,791,181)	($43,961,204)
+	Cost to Serve EV Charging	$1,640,576	$4,730,827	$14,934,092
=	Net Revenue from EV Charging	($5,686,676)	($15,060,353)	($29,027,112)
+	TEP Revenue Requirement	$8,119,657	$12,522,602	$17,838,681
=	Retail Rate Impact	$2,432,981	($2,537,751)	($11,188,431)
÷	Approximate Total Retail Revenues	$2,837,497,547	$2,894,247,498	$2,952,132,447
=	Retail Rate Impact - Percentage	0.1%	-0.1%	-0.4%