

**THE STATE OF NEW HAMPSHIRE**  
**BEFORE THE**  
**NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION**

**TESTIMONY OF EDWARD A. DAVIS**

**PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE**  
**D/B/A EVERSOURCE ENERGY**

**RESIDENTIAL ELECTRIC VEHICLE TIME-OF-USE RATES**

**Docket No. DE 20-170**

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1 **Q. Mr. Davis, please state your name, business address and position.**

2 A. My name is Edward A. Davis. My business address is 107 Selden Street, Berlin, CT  
3 06037. My position is Director, Rates at Eversource Energy Service Company and in that  
4 position I provide rate and tariff related services to the operating companies of  
5 Eversource Energy including Public Service Company of New Hampshire d/b/a  
6 Eversource Energy (“Eversource” or “the Company”).

7 **Q. Have you previously testified before the New Hampshire Public Utilities**  
8 **Commission?**

9 A. Yes. I have on many occasions testified before the New Hampshire Public Utilities  
10 Commission (“Commission”) on behalf of Eversource, and at the state utility

1 commissions in Connecticut and Massachusetts on behalf of other Eversource Energy  
2 affiliates on rate related matters.

3 **Q. Please describe your educational background and professional experience.**

4 A. I hold a Bachelor of Science degree in Electrical Engineering from the University of  
5 Hartford and Master of Business Administration from the University of Connecticut. I  
6 joined Northeast Utilities, now Eversource Energy, in 1979 and have held various  
7 positions in the areas of consumer economics, engineering and operations, wholesale and  
8 retail marketing and rate design, regulation and administration.

9 **Q. What is the purpose of this testimony?**

10 A. The purpose of my testimony is to submit and discuss the design for a residential electric  
11 vehicle (EV) time-of-use (TOU) rate. This design has been developed pursuant to the  
12 Commission's guidelines in Order 26,394 in Docket No. IR 20-004<sup>1</sup> (Order). The  
13 implementation of this proposed rate design, and the Company's proposed managed  
14 charging initiative are discussed in the testimony of Messrs. Moore, Goldman and Rice  
15 also submitted in this docket.

16 **Q. Please summarize the Company's rate design proposal.**

17 A. The Company has developed a residential EV TOU rate consisting of time-differentiated  
18 rates for the distribution, transmission and company-provided energy service components  
19 of rates. TOU pricing for peak, mid-peak and off-peak periods have been determined,

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<sup>1</sup> IR 20-004, Investigation into Rate Design Standards for Electric Vehicle Charging Stations and Electric Vehicle Time of Day Rates, Order No. 26,394 dated August 18, 2020.

1 based on the marginal cost of providing service for each of these components. The  
2 Company has aligned the cost of service and rate design of each component to achieve a  
3 five-hour peak period from 2 pm - 7pm, weekdays (excluding holidays), a daily mid-peak  
4 period from 7 am through 11 pm (excluding peak periods), and a daily off-peak from 11  
5 pm each day through 7 am the following day. A summary of this rate structure and  
6 associated pricing is provided in Table 1, below.

**Table 1**  
**3-Period Residential EV TOU Rate Summary**

|                | Off Peak   | Mid-Peak   | Peak       |
|----------------|------------|------------|------------|
| Distribution   | \$ 0.02065 | \$ 0.05988 | \$ 0.06402 |
| Transmission   | 0.01199    | 0.02070    | 0.08746    |
| Energy Service | 0.05026    | 0.06229    | 0.10294    |
| Total          | \$ 0.08290 | \$ 0.14287 | \$ 0.25442 |

**Time of Use Periods**

**Peak:** Weekdays: 2 pm -7 pm (excl. holidays)

**Mid-Peak:** Weekdays: 7am-2pm and 7pm-11pm ;Weekends: 7am - 11 pm

**Off-Peak:** Daily, 11 pm - 7 am

**Notes:**

Distribution pricing reflects adjustment to implement a \$16.50/month customer charge with local facilities costs included in peak & mid-peak

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8 **Q. Please discuss the overall characteristics of this rate design.**

9 A. In the Order, the Commission provided guidance and directives emphasizing the use of  
10 marginal costs as much as possible. The Order further requires separate TOU rates for  
11 the distribution, transmission and generation components of service, and provides several  
12 key measures that should be reflected in the overall design.

13 As an initial matter, in developing the proposed rate design the Company reviewed the

1 service to be provided and the associated costs of providing that service for a residential  
2 customer. The proposed Residential EV TOU Rate (Rate R-EV) assumes a residential  
3 customer's charging equipment will be separately metered but connected to the same  
4 service as the primary residence. This service arrangement is comparable to that for  
5 residential water heating service, which was discussed as a framework for residential EV  
6 charging during technical sessions in this docket. Accordingly, the Company has  
7 developed TOU rates for each component of service, based on a revenue neutral design  
8 that looks at the prevailing residential rates for these components, but allocates costs to  
9 peak, mid peak, and off-peak periods based on the respective marginal costs for each  
10 component.

11 For distribution marginal costs, in particular, the hourly marginal distribution substation  
12 costs used for this purpose were obtained from the Company's 2019 Distribution  
13 Marginal Cost of Service (MCS) study conducted by the Company's marginal cost  
14 consultant, Amparo Nieto, and the marginal generation and transmission cost estimates  
15 were obtained from an analysis conducted by the same MCS consultant, under Docket  
16 No. DE 19-057. These estimates were updated to 2021 dollars and were used to inform  
17 rates by time of day period, adjusted to meet revenue targets.<sup>2</sup>

18 An important consideration in developing these designs is to recognize the different types  
19 of marginal costs and when they occur within each component of service, and in defining  
20 each of the three periods (both duration and beginning/end times) for which to set rates,

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<sup>2</sup> Details of the Distribution Marginal Costs are available in Attachment MCOSS-1 to Amparo Nieto's Direct Testimony on Marginal Costs, submitted to the Commission in Docket DE 19-057. The marginal generation and transmission costs by period are available in Attachment EAD-1 to this testimony.

1 based on these costs. The Company's consultant evaluated where the strongest  
2 alignment of costs occurred among the three components of service, for three TOU  
3 periods as designated by the Commission.<sup>3</sup> Marginal cost differentials for each  
4 component of service and across those components were applied to achieve this  
5 alignment while taking into account a number of other objectives, including  
6 establishment of a five-hour peak period; attaining a minimum overall, annual average  
7 3:1 peak/off-peak ratio, and assuring that off-peak rates did not include the local fixed  
8 cost component. Attachment EAD-1 provides the details of the design that meet these  
9 objectives.

10 **Q. Please explain in more detail your proposed rate design and the guidelines and**  
11 **methodologies applied in developing this proposed rate design**

12 A. In developing distribution rates, the Company first evaluated the existing customer  
13 related costs as reflected in the customer charge of the optional residential TOD rate (R-  
14 OTOD). The marginal per-customer cost of local distribution facilities, as per the MCS in  
15 Docket No. DE 19-057, was removed from the existing Rate R-OTOD customer charge  
16 and included for recovery through the mid-peak and peak period volumetric rates. This  
17 resulted in a lower customer charge as compared to the R-OTOD rate, but the customer  
18 charge retained other customer costs, including that of the current TOU meter. The  
19 proposed approach is consistent with the service configuration previously described for  
20 the EV connection. Recovering the costs of the local transformer in the volumetric rate

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<sup>3</sup> The Company engaged Ms. Nieto, author of the Distribution MCS, to produce these peak, mid peak and off peak transmission costs.

1 component outside of the off-peak period provides price signals that encourage off-peak  
2 (overnight) EV charging and discourages charging at times that may cause the need for  
3 additional local facilities' capacity and thereby cause incremental costs to be incurred at  
4 the individual customer level (e.g., increased transformer/service requirements). The  
5 remaining costs of providing distribution service have been delineated on a TOU basis  
6 utilizing the marginal costs of the distribution system, provided in the Company's  
7 distribution marginal cost of service. As a result, the company has provided a marginal  
8 cost-based, three-period TOU rate for the distribution component of service, as  
9 summarized in Table 1 and detailed in Attachment EAD-1.

10 Three-period transmission TOU rates were developed using the probability of peak  
11 methodology applied from Docket No. DE 19-057, applied to the rate being billed to the  
12 Company for transmission service (i.e., the RNS rate) as the marginal unit cost of  
13 transmission service. The Company has developed the three-period TOU rate for  
14 transmission service using time-differentiated marginal costs of providing transmission  
15 service to residential customers at various times using this method, as shown in Table 1  
16 and detailed in Attachment EAD-1.

17 To determine the component of the EV rate that reflects the "Energy Supply service" by  
18 time of day, the Company applied current and forward-looking estimates of marginal  
19 costs of energy, capacity and other components of supply, as developed by the  
20 Company's consultant, adjusted as necessary to meet the revenue target for those  
21 components. The marginal cost of energy billed to customers is the price paid pursuant  
22 to the Company's procurement of that supply. This is a flat rate per kWh across all

1 hours, which changes twice a year. For purposes of setting a TOU rate for EV, the  
2 average energy price was time-differentiated (by time of day) using the average historical  
3 variation in locational marginal prices (i.e., locational marginal prices, or LMP) in the  
4 ISO-NE market. Finally, the Company applied time of day estimates of forward capacity  
5 prices in designing a rate for each of the three periods shown in Table 1, and detailed in  
6 Attachment EAD-1. In support of the rate design calculations provided in Attachment  
7 EAD-1, the Company plans to provide a supplement which will be made in a separate  
8 supporting filing to this docket on or around June 21, 2021.

9 It should be noted that this design aligns with marginal costs across all three components  
10 of service to achieve a greater than 3:1 peak/off-peak ratio. While the Commission  
11 recognized in its Order that a differential other than that of the marginal cost can be  
12 imputed into rates (e.g., the 3.5 cents/kWh differential under the CT two-period TOU  
13 rate), this design does not necessitate such an approach given the results produced on a  
14 marginal cost basis. Another important note for the energy supply portion of rates is,  
15 while the design addresses pricing of company-provided Energy Service, it does not  
16 resolve the issue of how to set or bill prices on a TOU basis for competitive supply. The  
17 Company's proposed rate design is cost reflective for each component of service by time  
18 of day. Competitive supply rates, however, are not required to be set on a TOU basis.  
19 Furthermore, where a competitive supplier bills customers directly, such rates would not  
20 be known by the Company at all. Where competitive supply rates are billed by the  
21 Company, while the rates are known by the company, the supplier determines the rates  
22 Eversource bills.

1           Regarding seasonality, the Company's design is set on a twice annual basis, using  
2           prevailing rates. Using the methodologies applied by the Company in this design, such  
3           rates would be updated as underlying rates (and where applicable or known, including  
4           associated marginal and reconciling costs) for each component change. As discussed in  
5           the Commission's Order, the cost of Energy Service would change twice annually (e.g.,  
6           February 1 and August 1). The marginal cost differential applied within the design of  
7           such rates would be an important factor in determining what the peak/off-peak ratio  
8           might be during a given year. The Company notes that further seasonality could be  
9           explored within both the distribution and transmission components of rates, based on the  
10          marginal cost of service analyses it has performed.

11          It should also be noted that the customer components of costs, whether in the customer  
12          charge or volumetric rates as discussed above, do not fully reflect additional costs of  
13          metering, meter reading, data collection, etc. that would be required to provide service to  
14          EV customers under the proposed EV TOU design. While the three-part EV TOU rate  
15          design discussed above reflects the cost of deploying a current TOU meter, incremental  
16          costs are addressed in the previously noted joint testimony of Dennis Moore, Michael  
17          Goldman and Brian Rice.

18   **Q.    Please discuss the tariff requirements of the proposed rate design**

19    A.    As required by the Commission in the Order, the Company is providing an illustrative  
20          tariff reflecting the proposed rate design. Please see Attachment EAD-2. This tariff  
21          provides the general form of tariff and a schedule of rates. Detailed availability and other  
22          provisions are to be determined, but are anticipated to be based on service provisions of



1 the current residential tariff, and requirements for providing electric service to residential  
2 EV chargers as reflected in rate design.

3 **Q. Does the Company recommend implementing the proposed rate design at this time?**

4 A. No. As previously noted and discussed more thoroughly in accompanying testimony of  
5 Dennis Moore, Michael Goldman and Brian Rice, the Company does not recommend the  
6 near-term implementation of a separately-metered EV TOU rate. Making the rate  
7 structure described in this testimony available to customers would require substantial  
8 modification to many of the Company's current enterprise systems and comparable  
9 outcomes can be achieved at much lower cost through a proposed managed charging  
10 initiative

11 **Q. Please discuss bill savings under the proposed Residential EV TOU rate design and**  
12 **how that data informs the Company's proposed load management initiative.**

13 A. Attachment EAD-3 provides an analysis of the reduction in a residential EV customer's  
14 bill by moving to a TOU rate and charging only during the off-peak period. There are  
15 clear savings due to the volumetric TOU rate differential, but those savings are offset by  
16 fixed costs of implementing a separate rate. Thus, there are questions about how much is  
17 ultimately and comparatively saved compared with charging an EV as part of the whole  
18 house rate and factoring in incentives such as those available under the management  
19 charging program. The analysis in Attachment EAD-3 shows volumetric bill savings for  
20 a hypothetical residential EV charger on the EV TOU rate that are offset by the additional  
21 service charge under that rate. In that example, a BEV that meets 80% of their charging  
22 requirements at home would consume 260 kWh. If all charging were performed during

1 the off-peak period, this customer would be able to reduce their per kWh rate by  
2 approximately 6.5 cents/kWh, and realize a \$16.81 bill savings, when compared with  
3 charging under the Company's whole house rate, Rate R (which employs a flat rate for all  
4 hours, for all components of service). Given the charging occurs under a separately  
5 metered TOU rate, there is an additional customer charge (\$16.50 per month), which  
6 offsets the volumetric savings for a net savings of \$0.31. As discussed further in the  
7 testimony of Messrs. Moore, Goldman and Rice, additional fixed costs will be required to  
8 implement this design, which would further reduce net savings to the point where it's  
9 doubtful that there would be any savings at all.

10 **Q. Please summarize the Company's proposed, three-period rate design.**

11 A. The Company believes it has been important to develop the three-period EV TOU  
12 proposal to obtain insights into pricing of the various time-differentiated services  
13 applicable to EV charging. While the EV TOU rate has been designed to meet objectives  
14 directed by the Commission's Order, it is important to recognize the contextual and  
15 practical considerations and challenges in implementing such rates. This includes  
16 consideration of the relative benefits possible for a customer charging under an EV TOU  
17 rate compared with charging at rates for overall service to their residence, whether Rate R  
18 or Rate R-OTOD, plus the possible benefits of adding managed charging incentives to  
19 these overall service rates. The net savings from the EV TOU rate design appear to be  
20 relatively small compared with other rate alternatives such as managed charging. The  
21 additional metering and billing requirements and costs to implement the EV TOU rate  
22 need to be weighed against savings that are more directly and readily achievable through

1           the managed charging program. Even without the additional fixed costs associated with  
2           EV TOU implementation, savings are small. Nonetheless, TOU rates can eventually  
3           bring benefit when the market develops further.

4   **Q.    Does this conclude your testimony?**

5   **A.    Yes. It does.**

**Residential EV TOU Rate Design**

**Rate Design Revenue Requirements**

|                           |                         |                     |
|---------------------------|-------------------------|---------------------|
| Distribution              |                         |                     |
|                           | Total <sup>1</sup>      | \$ 245,789,395      |
|                           | Customer <sup>2</sup>   | <u>(87,272,856)</u> |
|                           | Volumetric <sup>3</sup> | \$ 158,516,539      |
| Transmission <sup>3</sup> |                         | \$ 94,695,072       |
| Generation <sup>3</sup>   |                         | \$ 208,417,217      |

**Marginal Costs<sup>4,5</sup>**

MC Differentials

Mid-Peak to Off-Peak

|  | Peak     | Mid-Peak | Off-Peak | Peak to Mid-Peak | Mid-Peak to Off-Peak |
|--|----------|----------|----------|------------------|----------------------|
|  | (\$/kWh) | (\$/kWh) | (\$/kWh) | (\$/kWh)         | (\$/kWh)             |
| Generation                               | 0.08768  | 0.04702  | 0.03499  | 0.04066          | 0.01203              |
| Distribution (system level) <sup>6</sup> | 0.00483  | 0.00069  | 0.00000  | 0.00414          | 0.00069              |
| Transmission                             | 0.07569  | 0.00894  | 0.00023  | 0.06675          | 0.00871              |

**Rate Design TOU Periods and Billing Determinants**

Peak Period: 2 pm - 7 pm, weekdays excluding holidays  
Mid-Peak Period: 7 am - 11 pm, daily, excluding peak period hours  
Off-Peak Period: All other hours

kWh Usage

| Peak        | Mid-Peak      | Off-Peak    | Total         |
|-------------|---------------|-------------|---------------|
| 549,957,946 | 1,777,416,681 | 817,596,207 | 3,144,970,835 |
| 17.5%       | 56.5%         | 26.0%       |               |

**MC-based Rate Design<sup>7</sup>**

|  | Peak     | Mid-Peak | Off-Peak | Rate Design Revenue Target | Peak/ Off-peak ratio |
|--|----------|----------|----------|----------------------------|----------------------|
|  | (\$/kWh) | (\$/kWh) | (\$/kWh) |                            |                      |
| Distribution (system level) <sup>6</sup> | 0.06402  | 0.05988  | 0.02065  | \$ 158,516,539             | 3.10                 |
| Transmission                             | 0.08746  | 0.02070  | 0.01199  | \$ 94,695,072              | 7.29                 |
| Generation                               | 0.10294  | 0.06229  | 0.05026  | \$ 208,417,217             | 2.05                 |
| Total                                    | 0.25442  | 0.14287  | 0.08290  |                            | 3.07                 |

**Notes**

<sup>1</sup> Total Rate R Revenue Requirement (approved by NH PUC in DE 19-057)

<sup>2</sup> Customer Charge Revenue (\$16.50/month, from Rate R-TOD customer charge, excluding local facilities marginal cost moved to peak/mid-peak volumetric rate)

<sup>3</sup> Total revenue target for time differentiated volumetric rate design

<sup>4</sup> Best fit analysis to combine distribution, transmission and generation marginal costs for designated peak and associated mid-peak and off-peak TOU periods

<sup>5</sup> Marginal costs for distribution from marginal COS study in DE 19-057, for transmission from probability of peak analysis and generation from energy supply MC analysis

<sup>6</sup> Local distribution costs included in peak/mid-peak volumetric rate components

<sup>7</sup> Detailed calculations provided in Workpaper EAD-1

Public Service Company of New Hampshire  
d/b/a Eversource Energy  
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Attachment EAD-2  
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NHPUC NO. 10 - ELECTRICITY DELIVERY  
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE  
DBA EVERSOURCE ENERGY

Original Page  
Rate R-EV

RESIDENTIAL ELECTRIC VEHICLE RATE

AVAILABILITY

[TBD]

CHARACTER OF SERVICE

Service supplied under this rate will be single-phase, 60 hertz, alternating current, normally three-wire at a nominal voltage of 120/240 volts.

RATE PER MONTH

Customer Charge .....\$16.50 per month

Energy Charges:

Per Kilowatt-Hour

Distribution Charges:

On-Peak Hours (2:00 p.m. to 7:00 p.m.  
weekdays excluding Holidays) .....2.065¢

Mid-Peak Hours (daily 7:00 a.m.to 11 p.m.,  
excluding On-Peak Hours) ..... 5.988¢

Off-Peak Hours (all other hours) .....6.402¢

Regulatory Reconciliation Adjustment.... ....0.000¢

Transmission Charges:

On-Peak Hours (2:00 p.m. to 7:00 p.m.  
weekdays excluding Holidays) ..... 8.746¢

Mid-Peak Hours (daily 7:00 a.m.to 11 p.m.,  
excluding On-Peak Hours) ..... 2.070¢

Off-Peak Hours (all other hours) ..... 1.199¢

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NHPUC NO. 10 - ELECTRICITY DELIVERY  
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE  
DBA EVERSOURCE ENERGY

Original Page  
Rate R-EV

Energy Service Charges:

|  |         |
|--|---------|
| On-Peak Hours (2:00 p.m. to 7:00 p.m.<br>weekdays excluding Holidays) .....  | 10.294¢ |
| Mid-Peak Hours (daily 7:00 a.m.to 11 p.m.,<br>excluding On-Peak Hours) ..... | 6.229¢  |
| Off-Peak Hours (all other hours) .....                                       | 5.026¢  |
| Stranded Cost Recovery.....  | 0.844¢  |

ILLUSTRATIVE

**Residential EV Charging  
TOU Rate Savings Estimate**

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|   | BEV 2021        | PHEV 2021        |
|---|-----------------|------------------|
| <b>Total Monthly Charge (kWh)</b>                 | 325             | 206              |
| <b>% Residential Charging</b>                     | 0.80            | 0.80             |
| <b>At Home Charging (kWh)</b>                     | 260             | 200              |
| <b>Distribution Off-Peak Charging Savings *</b>   | \$ 7.93         | \$ 6.10          |
| <b>Transmission Off-Peak Charging Savings *</b>   | 4.71            | 3.62             |
| <b>Energy Service Off-Peak Charging Savings *</b> | 4.16            | 3.20             |
| <b>Total Savings from Off-Peak Charging</b>       | <b>\$ 16.81</b> | <b>\$ 12.93</b>  |
| <b>Customer Charge</b>                            | (16.50)         | (16.50)          |
| <b>Net Savings</b>                                | <b>\$ 0.31</b>  | <b>\$ (3.57)</b> |

**3-Period Residential EV TOU Rate Summary**

**Customer Charge** \$16.50 per month

**Volumetric Rates (\$/kWh)**

|                | <i>Proposed TOU Rates</i> |                |                | <i>Comparative Rates</i> |                   |
|----------------|---------------------------|----------------|----------------|--------------------------|-------------------|
|                | Off Peak                  | Mid-Peak       | Peak           | Rate R (all hours)       | Price Δ *         |
| Distribution   | 0.02065                   | 0.05988        | 0.06402        | 0.05116                  | \$ 0.03051        |
| Transmission   | 0.01199                   | 0.02070        | 0.08746        | 0.03011                  | \$ 0.01812        |
| Energy Service | 0.05026                   | 0.06229        | 0.10294        | 0.06627                  | \$ 0.01601        |
| <b>Total</b>   | <b>0.08290</b>            | <b>0.14287</b> | <b>0.25442</b> | <b>0.14754</b>           | <b>\$ 0.06464</b> |

**Time of Use Periods**

Peak: Weekdays: 2 pm -7 pm (excl. holidays)  
Mid-Peak: Weekdays: 7am-2pm and 7pm-11pm ;Weekends: 7am - 11 pm  
Off-Peak: Daily, 11 pm - 7 am

**Notes:**

Distribution pricing reflects adjustment to implement a \$16.50/month customer charge with local facilities costs included in peak & mid-peak rates.

\* Savings calculated from shifting 100% charging to off peak, and difference between Rate R all hours and TOU off-peak rates.