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Joint work with Drs. Muratori & Eichman, NREL
TE3 October 18, 2019
US Fast Charging Infrastructure

- Fast charging stations coverage and prices (Y 2018)

- Known prices: 1,294 stations [EVgo, Tesla, Blink, Webasto]
  - Mean: 0.35 $/kWh
  - Median: 0.26 $/kWh
  - Standard Deviation: 0.22 $/kWh

Legend
DCFC Charger Prices [$/kWh]- Stations
- 0.16 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.69
- Price Not Applicable
- Contiguous United States
Electricity Costs of Fast Charging Providers

- Issues with electricity rates

Report: Public Electric-Car Chargers Are Being Crushed by Demand Charges

Those fees need to be slashed for public electric car charging to make sense, says a new Rocky Mountain Institute report.

KATIE FEHRENBACKER | APRIL 06, 2017

FEATURE
Is utility rate design the key to widespread electric vehicle adoption?

Electricity rate structure can make or break the business case for independent charging stations

Steep utility fees are killing electric-car charging stations

Areg Bagdasarian
Friday, January 12, 2018 - 1:35am
## Electricity Bill Example

- **Types of charges**

### SDG1 Annual Electric Bill

<table>
<thead>
<tr>
<th></th>
<th>Usage (kWh)</th>
<th>Cost ($/kWh)</th>
<th>Total cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy</strong></td>
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<td></td>
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<tr>
<td>Max</td>
<td>13,085</td>
<td>0.11447</td>
<td>1,497.82</td>
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<td></td>
<td>7,827</td>
<td>0.10565</td>
<td>826.97</td>
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<tr>
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<td>1,612.59</td>
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<td>0.09132</td>
<td>3,213.46</td>
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<tr>
<td>Port-Peak</td>
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<td>0.07920</td>
<td>2,135.17</td>
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<tr>
<td></td>
<td>46,612</td>
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<td>3,397.42</td>
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<tr>
<td><strong>Total</strong></td>
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<td></td>
<td>144,932</td>
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<tr>
<td><strong>Demand</strong></td>
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<tr>
<td>Avg peak</td>
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<tr>
<td>Max</td>
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<td>22.55</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>Fixed</strong></td>
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<td>Meter charge</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>Total Annual Bill</strong></td>
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<td>$25,972.01</td>
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Research Scope

- Evaluate **average cost of electricity**\(^2\) for **electric vehicle fast charging providers and operators** in the United States
  - illustrative scenarios for charging units specification
  - comparison of rates with and w/o demand charges

\(^2\) Evidence of high avg. electricity costs provided in the following empirical reports:
- Fitzgerald G, Nelder C (2017) EVgo fleet and Tariff Analysis - Phase 1: California. (Rocky Mountain Institute, Boulder)
Leveraging NREL’s utility rate database (URDB), pinpoint commercial and industrial electric utility rates (> 25,000) and 7,500 commercial rates potentially applicable to fast charging.

Fast Charging Scenarios

**Existing small DCFC stations at low levels of utilization**

- Number of plugs: 1
- Plug power: 50 kW
- Station power: 50 kW
- Timeline: 2016
- BEV battery: 24 kWh
- End-charging SOC: 75%
- Energy: 8.8 kWh/charge
- Recharging: 1/day
- Charge time: ~11 min
- Load factor: ~1%

**Future intermediate DCFC stations**

- Number of plugs: 4
- Plug power: 150 kW
- Station power: 300 kW
- Timeline: 2020-2025
- BEV battery: 60 kWh
- End-charging SOC: 75%
- Energy: 38 kWh/charge
- Recharging: 48/day
- Charge time: ~15 min
- Load factor: ~25%
Charging Energy Impacts

- Electricity cost for scenarios over range of # average kWh per charge

- Higher energy drawn from the grid per charge mitigates cost
- When kWh per charge increase, rates with demand charges become preferable
Charger Utilization Impacts

- Electricity cost for scenarios over range of # of daily charging events

![Graph showing average electricity cost per day for 1 Plug - 50 kW and 4 Plugs - 150 kW with and without demand charges.]

- Higher levels of station utilization mitigate high electricity costs
- Rates without demand charges preferable when utilization levels are low
- Rates with demand charges preferable when utilization levels are high
Conclusions

Electricity cost for fast charging insights

- for small, low utilized fast charging stations observe higher avg electricity costs and the largest cost variability among different rates
- cost can be reduced when stations are used by more drivers or drivers consume greater electricity volume per charging event
- costs can be reduced with appropriate electricity rate-making
  1. only rates with energy charges in the early stages of transportation electrification
  2. transition to tariffs with demand charges and lower energy charges as charging station utilization increases
  3. agreements with fleet owners and ridehailing services to induce demand
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**Study’s Reference**