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Charge for Less

An Analysis of Electricity Pricing for Electric Vehicles in Ameren Territory

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Introduction

Once a subject of prophecy, electric vehicles (EVs) have arrived.

While currently a small share of overall car purchases in most countries, they are becoming a familiar sight on roads – and industry analysts predict EV sales will grow at a robust clip in the next decade, as consumers become familiar with their technological advantages, and as anticipated cost reductions and extended driving ranges turn EVs into appealing alternatives to gasoline-burning cars.[1] Illinois itself is showing signs of this bright EV future: In Normal, Rivian is transforming a shuttered Mitsubishi factory into an EV manufacturing plant that will employ as many as 1,000 workers.

> ***We find that EV drivers on hourly pricing would save 50-51% on their energy costs.***

Transportation electrification presents both opportunities and challenges for utility consumers. According to the U.S. Department of Energy's National Renewable Resources Laboratory, millions of EVs on the road could increase overall U.S. electricity demand by 38 percent, or up to a sustained 80 terawatt hours per year.[2]

If not managed appropriately, such an increase in usage could require costly expansion of electric system delivery and generation capacity.

Yet the Rocky Mountain Institute shows that increased power usage associated with transportation electrification could be largely accommodated without additional power plants or grid expansion *if* EVs are charged at optimal times.[3] In fact, a CUB study in 2019, "Charging Ahead: Deriving Value from Electric Vehicles for All Electricity Customers," found that well-managed, or optimized, electric vehicle charging could produce up to $2.6 billion in cumulative consumer savings in Illinois through 2030.[4]

How can we make sure that EVs charge at the right times? While multiple strategies may be required, time-variant rates are almost certainly the cheapest way to accomplish this aim.[5]

By motivating EV owners to charge their vehicles when power supply exceeds demand, dynamic pricing can improve system load shape and capacity utilization, reduce consumer costs, and cut pollution.

Particularly in states that have deployed smart meters, implementing that simple policy option can make EVs a substantial source of system benefit, even

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[1] Bloomberg New Energy Finance, for example, predicts that by 2040 EVs will capture 55% of all new car sales and comprise 33% of the total vehicle fleet. https://about.bnef.com/electric-vehicle-outlook/

[2] Mai, Trieu, Paige Jadun, Jeffrey Logan, Colin McMillan, Matteo Muratori, Daniel Steinberg, Laura Vimmerstedt, Ryan Jones, Benjamin Haley, and Brent Nelson. 2018. Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-71500. https://www.nrel.gov/docs/fy18osti/71500.pdf

[3] https://www.rmi.org/insight/from_gas_to_grid/

[4] Charging Ahead: Deriving Value from Electric Vehicles for All Electricity Customers (Vol. 2 in the ABCs of EVs Series). Citizens Utility Board. https://www.citizensutilityboard.org/wp-content/uploads/2019/03/Charging-Ahead-Deriving-Value-from-Electric-Vehicles-for-All-Electricity-Customers-v6-031419.pdf

[5] While dynamic pricing and rate design can go a long way toward addressing these issues, to further capture the system benefits of EVs' load flexibility requires smart charging. See Cohen, Martin. 2017. The ABCs of EVs: A Guide for Policy Makers and Consumer Advocates. Citizens Utility Board. https://citizensutilityboard.org/wp-content/uploads/2017/04/2017_The-ABCs-of-EVs-Report.pdf

for those who don't drive or own an EV.

Some utility EV programs to date have assumed that EVs will be price-responsive without necessarily putting into place measures that guarantee price-responsiveness.[6]

There are several reasons for this – including the fact that we are still in the early stages of EV deployment and thus may lack a perceived sense of urgency. But the biggest reason is likely that dynamic pricing remains little understood, largely because of the lack of robust analysis utilizing real data on the predicted impacts of new rate designs.

While we disagree with some of her conclusions, dynamic pricing critic Barbara Alexander is correct when she says that it is "poor public policy to leap into (new methods of pricing) electricity service to residential customers without a careful analysis and access to factual information on the impacts of such proposals on customer bills."[7]

In this paper, we attempt to fill this information gap within the realm of EVs by comparing what customers of Illinois utility Ameren Illinois would have paid in 2018 to charge their vehicles under average rates compared to its hourly pricing program, Power Smart Pricing.

In an earlier paper, published in the World Electric Vehicle Journal, CUB found potential energy savings of 52 percent to 59 percent for EV drivers in northern Illinois, who are in the PJM Regional Transmission Organization. [8] In this analysis, we use the same methodology as before, but focus on the Ameren service territory, which is part of the Midcontinent Independent System Operator (MISO). Using three representative battery ranges and four representative daily driving amounts, we find that hourly prices would have yielded energy cost savings ranging between 50 and 51 percent, depending upon the circumstances, for EV drivers.

We then supplement these empirical findings with a normative recommendation – policymakers should implement "opt-out" dynamic rates for EV charging and charging infrastructure, as none of the relevant conditions typically invoked to support flat-rate pricing are present in the case of EVs.

With the aid of the sophisticated sensor and data-analysis capabilities prevalent in vehicle charging technology, utilities could isolate EV-related consumption, making a separate opt-out policy feasible should policymakers decide to preserve the consumer's prerogative to opt-in to hourly pricing for other forms of household usage.

Fig. 1		**Battery Size**	**Max Charge Rate (L2)**	**kWh/100m**	**Range**
Prius Prime[9]	PHEV	8.8 kWh	3.3 kW	25.9 EV/1.38 Hybrid	30 EV/640 Hybrid
Bolt[10]	EV	60 kWh	7.7 kW	28	230
Tesla[11]	EV	75	11.5 kW	26	310

Fig. 2

Product	**Charge Rate**
ChargePoint CT4000 L2[12]	7.2 kW
ChargePoint Express 200 DC[13]	50 kW

Fig. 3: Daily miles traveled

PHEV	15 (Light)	30 (Average)	50 (Heavy)	100 (Lyft/Uber)
Bolt	15 (Light)	30 (Average)	50 (Heavy)	100 (Lyft/Uber)
Tesla	15 (Light)	30 (Average)	50 (Heavy)	100 (Lyft/Uber)

We conclude by outlining why hourly pricing has several key advantages over time-of-use rates if the goal is (as it should be) to "charge for less" in both the economic and environmental sense of the term.

Theory and Calculations

In this paper, we use actual 2018 MISO locational marginal prices (LMP) to compare what perfectly rational EV drivers would pay to charge their vehicle on Ameren's Power Smart Pricing program with costs associated with the utility's flat-rate energy price for both Level 2 and Level 3 DC fast charging.

We started by choosing three representative electric vehicles: the 2018 Toyota Prius Prime, the 2018 Chevy Bolt, and the Tesla 3 Long-Range (**Fig. 1**). These vehicles offer a range of battery sizes, power efficiencies, and maximum A/C charging rates, and serve as good examples of products currently on the market.

In the next step, we chose off-the-shelf representative Level 2 and Level 3 chargers to estimate the maximum achievable charge rate. **Fig. 2** summarizes the specs for the two selected products from ChargePoint.

Next, while the model was constructed to allow

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[6] Southern California Edison and DTE Energy and Consumer Energy's recent filings – while not perfect – are notable exceptions and we hope they reflect increased attention on the importance of dynamic pricing by utilities, PUCs, and advocates.

[7] Alexander, Barbara. 2007. Smart Meters, Real Time Pricing, and Demand Response Programs: Implications for Low Income Electric Customers. Oak Ridge, TN: Oak Ridge National Laboratory UT-Battelle, LLC Purchase Order No. 4000049807

[8] World Electric Vehicle Journal 2019, 10(1), 6

[9] https://www.toyota.com/priusprime/

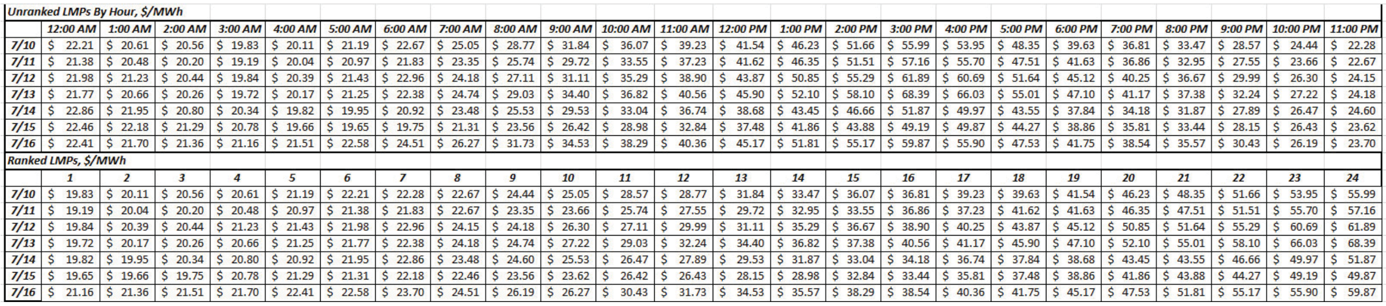
[10] https://www.gmfleet.com/chevrolet/bolt-ev-electric-vehicle/features-specs-trims-dimensions

[11] https://www.tesla.com/model3

[12] https://www.chargepoint.com/files/datasheets/ds-ct4000.pdf

[13] https://www.chargepoint.com/files/datasheets/ds-cpe200.pdf

Fig. 4: Sample Week, July 10-16, 2018



Unranked LMPs By Hour, $/MWh

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
7/10	$ 22.21	$ 20.61	$ 20.56	$ 19.83	$ 20.11	$ 21.19	$ 22.67	$ 25.05	$ 28.77	$ 31.84	$ 36.07	$ 39.23	$ 41.54	$ 46.23	$ 51.66	$ 55.99	$ 53.95	$ 48.35	$ 39.63	$ 36.81	$ 33.47	$ 28.57	$ 24.44	$ 22.28
7/11	$ 21.38	$ 20.48	$ 20.20	$ 19.19	$ 20.04	$ 20.97	$ 21.83	$ 23.35	$ 25.74	$ 29.72	$ 33.55	$ 37.23	$ 41.62	$ 46.35	$ 51.51	$ 57.16	$ 55.70	$ 47.51	$ 41.63	$ 36.86	$ 32.95	$ 27.55	$ 23.66	$ 22.67
7/12	$ 21.98	$ 21.23	$ 20.44	$ 19.84	$ 20.39	$ 21.43	$ 22.96	$ 24.18	$ 27.11	$ 31.11	$ 35.29	$ 38.90	$ 43.87	$ 50.85	$ 55.29	$ 61.89	$ 60.69	$ 51.64	$ 45.12	$ 40.25	$ 36.67	$ 29.99	$ 26.30	$ 24.15
7/13	$ 21.77	$ 20.66	$ 20.26	$ 19.72	$ 20.17	$ 21.25	$ 22.38	$ 24.74	$ 29.03	$ 34.40	$ 36.82	$ 40.56	$ 45.90	$ 52.10	$ 58.10	$ 68.39	$ 66.03	$ 55.01	$ 47.10	$ 41.17	$ 37.38	$ 32.24	$ 27.22	$ 24.18
7/14	$ 22.86	$ 21.95	$ 20.80	$ 20.34	$ 19.82	$ 19.95	$ 20.92	$ 23.48	$ 25.53	$ 29.53	$ 33.04	$ 36.74	$ 38.68	$ 43.45	$ 46.66	$ 51.87	$ 49.97	$ 43.55	$ 37.84	$ 34.18	$ 31.87	$ 27.89	$ 26.47	$ 24.60
7/15	$ 22.46	$ 22.18	$ 21.29	$ 20.78	$ 19.66	$ 19.65	$ 19.75	$ 21.31	$ 23.56	$ 26.42	$ 28.98	$ 32.84	$ 37.48	$ 41.86	$ 43.88	$ 49.19	$ 49.87	$ 44.27	$ 38.86	$ 35.81	$ 33.44	$ 28.15	$ 26.43	$ 23.62
7/16	$ 22.41	$ 21.70	$ 21.36	$ 21.16	$ 21.51	$ 22.58	$ 24.51	$ 26.27	$ 31.73	$ 34.53	$ 38.29	$ 40.36	$ 45.17	$ 51.81	$ 55.17	$ 59.87	$ 55.90	$ 47.53	$ 41.75	$ 38.54	$ 35.57	$ 30.43	$ 26.19	$ 23.70

Ranked LMPs, $/MWh

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
7/10	$ 19.83	$ 20.11	$ 20.56	$ 20.61	$ 21.19	$ 22.21	$ 22.28	$ 22.67	$ 24.44	$ 25.05	$ 28.57	$ 28.77	$ 31.84	$ 33.47	$ 36.07	$ 36.81	$ 39.23	$ 39.63	$ 41.54	$ 46.23	$ 48.35	$ 51.66	$ 53.95	$ 55.99
7/11	$ 19.19	$ 20.04	$ 20.20	$ 20.48	$ 20.97	$ 21.38	$ 21.83	$ 22.67	$ 23.35	$ 23.66	$ 25.74	$ 27.55	$ 29.72	$ 32.95	$ 33.55	$ 36.86	$ 37.23	$ 41.62	$ 41.63	$ 46.35	$ 47.51	$ 51.51	$ 55.70	$ 57.16
7/12	$ 19.84	$ 20.39	$ 20.44	$ 21.23	$ 21.43	$ 21.98	$ 22.96	$ 24.15	$ 24.18	$ 26.30	$ 27.11	$ 29.99	$ 31.11	$ 35.29	$ 36.67	$ 38.90	$ 40.25	$ 43.87	$ 45.12	$ 50.85	$ 51.64	$ 55.29	$ 60.69	$ 61.89
7/13	$ 19.72	$ 20.17	$ 20.26	$ 20.66	$ 21.25	$ 21.77	$ 22.38	$ 24.18	$ 24.74	$ 27.22	$ 29.03	$ 32.24	$ 34.40	$ 36.82	$ 37.38	$ 40.56	$ 41.17	$ 45.90	$ 47.10	$ 52.10	$ 55.01	$ 58.10	$ 66.03	$ 68.39
7/14	$ 19.82	$ 19.95	$ 20.34	$ 20.80	$ 20.92	$ 21.95	$ 22.86	$ 23.48	$ 24.60	$ 25.53	$ 26.47	$ 27.89	$ 29.53	$ 31.87	$ 33.04	$ 34.18	$ 36.74	$ 37.84	$ 38.68	$ 43.45	$ 43.55	$ 46.66	$ 49.97	$ 51.87
7/15	$ 19.65	$ 19.66	$ 19.75	$ 20.78	$ 21.29	$ 21.31	$ 22.18	$ 22.46	$ 23.56	$ 23.62	$ 26.42	$ 26.43	$ 28.15	$ 28.98	$ 32.84	$ 33.44	$ 35.81	$ 37.48	$ 38.86	$ 41.86	$ 43.88	$ 44.27	$ 49.19	$ 49.87
7/16	$ 21.16	$ 21.36	$ 21.51	$ 21.70	$ 22.41	$ 22.58	$ 23.70	$ 24.51	$ 26.19	$ 26.27	$ 30.43	$ 31.73	$ 34.53	$ 35.57	$ 38.29	$ 38.54	$ 40.36	$ 41.75	$ 45.17	$ 47.53	$ 51.81	$ 55.17	$ 55.90	$ 59.87

testing of any driving level, we picked four typical daily driving amounts to simplify presentation: 15 miles (light driver); 30 miles (average driver); 50 miles (heavy driver); and 100 miles (ride share driver).[14] In the end, then, we ran the model quantifying the results for twelve overall cells (**Fig. 3**).

With these assumptions in place, we calculated what EV drivers would pay to charge their car on Ameren's flat-rate energy tariff to meet their daily driving needs. Because this tariff includes recovery of capacity costs and certain administrative costs, it was necessary to isolate the energy-supply-only component of the flat-rate charge to allow for an accurate comparison with hourly pricing.

These Purchased Electricity Charges (PECs) were calculated by combining Illinois Power Agency (IPA) procurement results for the study delivery year, and taking the seasonal weighted average price of energy for each month.[15]

Daily flat-rate charges were determined by multiplying the total energy required for battery recharge by the prevailing PEC for that month. Consumers on Ameren's hourly pricing program are charged MISO's real-time Ameren Zonal Residual LMP for their hourly volumes.[16]

To calculate the costs of charging vehicles on hourly pricing, we took the hourly prices for each day in 2018 from MISO, and placed them in ascending rank order.[17] **Fig. 4** summarizes the process for the week of July 10-16, 2018.

The required daily recharge consumption is deter-

Fig. 5

$$\mathrm{DHC} = \mathrm{LMP_T} * (\mathrm{CHR} - (\mathrm{T}-1) * \mathrm{VCR}) + \sum_{n=1}^{T-1} \mathrm{VCR} * \mathrm{LMP_n}$$

$$\mathrm{T} = \lceil \mathrm{CHR}/\mathrm{VCR} \rceil$$

DHC: Daily Hourly Charges ($)

The dollar value of electric supply charges resulting from battery recharge under scenario and vehicle conditions using optimized hourly charging.

VCR: Vehicle Charge Rate (kW)

The maximum hourly charging rate for test vehicle.

T: Charging Hours (H)

The total number of hours required to recharge battery under test conditions, rounded to the next whole hour.

CHR: Charge Required (kWh)

The total amount of energy required to recharge battery under test conditions.

LMP$_n$

LMP during nth lowest ranked hour of day ($/kWh)

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[14] See https://doi.org/10.1016/j.trb.2017.04.008 and https://newsroom.aaa.com/2015/04/new-study-reveals-much-motorists-drive/

[15] The IPA procures energy for eligible retail customers in monthly on- and off-peak blocks, according to Ameren's load projections. For summer and non-summer seasons, Ameren calculates Purchased Energy Charges (PECs) equal to the weighted average cost of that energy.

"Eligible retail customers" refers to residential and small commercial customers not taking energy supply from an alternative retail energy supplier or through a municipal aggregation agreement. Summer months run from June through September; non-summer months include October through May.

[16] For more information on Ameren's Power Smart Pricing program, see https://www.powersmartpricing.org/. Illinois is the only state in the U.S. where the two largest utilities (ComEd and Ameren Illinois) offer comprehensive, "opt-in" real-time pricing programs to all residential customers.

[17] https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports

mined by each vehicle's kWh/mile drive efficiency, divided by the number of miles in a given driving scenario.[18] For Level 2 charging, the hourly recharge consumption is equal to the vehicle's maximum A/C charge rate, and the number of charge hours equals the total kWh recharge volume divided by the hourly rate. For Level 3 charging, the recharge rate depends on the charger's rating, rather than the vehicles; in this case, the cars recharged at 50 kW per hour, for less than an hour, in all scenarios.

From this, an optimal daily charging amount was calculated as the sum of the minimal amount of charging consumption needed to meet daily driving needs multiplied by LMP during the required number of charging hours, starting with the lowest priced LMP hour and moving to the next rank-ordered LMP hour if necessary.

More specifically, the respective vehicle's kW charging rate was multiplied by the LMP for each day's lowest ranking LMP hours up to the total number of required charging hours less one, with the final hour being assessed the remaining kWh required (**Fig. 5**).

Once optimized hourly and flat-rate charging costs were calculated, we finally compared the total charging costs for each car and driving scenario by summing the daily costs for both rate options in 2018 and then calculating the difference between the two total cost summations.

Results

Ameren's Power Smart Pricing program would have saved EV owners significantly over its flat-rate tariff in 2018, with cost reductions **from 50 percent to 51 percent, equaling as much as $220 over the study period**. **Fig. 6** summarizes the results for the 12 scenarios in the case of Level 2 Charging.

Given the daily driving amounts tested and the 50 KW charge rate, every vehicle saves 51 percent with Power Smart Pricing over flat-rate pricing using Level 3 DC charging.

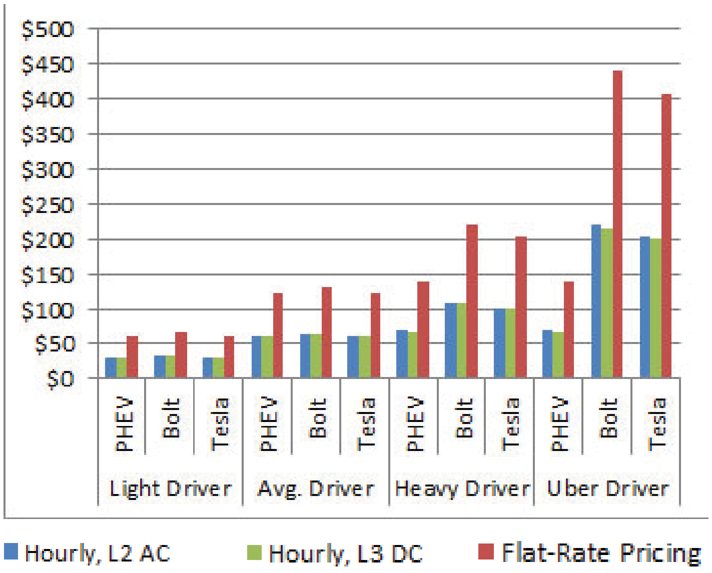
Because this analysis assumes a perfectly rational consumer who only charges in the cheapest hour(s) needed to meet her driving needs, by definition Level 3 charging occurs during the hour with the lowest priced energy, and thus every vehicle and driving scenario has the same percentage savings.

Total cost savings ranged from $31 to $220, depending upon the circumstances. Fig. 7 summarizes the fuel cost results of the overall analysis.

Fig. 6: Results, Level 2 Charging

		Hourly	Flat-rate	% Savings Hourly	$ Savings Hourly
Light driver	PHEV	$30	$61	51%	$31
	Bolt	$32	$66	51%	$34
	Tesla	$30	$61	51%	$31
Average driver	PHEV	$60	$122	51%	$62
	Bolt	$65	$132	51%	$67
	Tesla	$60	$122	51%	$62
Heavy driver	PHEV	$68	$138	50%	$70
	Bolt	$108	$220	51%	$111
	Tesla	$100	$204	51%	$103
Ride share	PHEV	$68	$138	50%	$70
	Bolt	$219	$439	50%	$220
	Tesla	$203	$408	50%	$204

Fig. 7: 2018 fuel cost comparison



A few notes are in order. First, this is an energy-only analysis and thus does not include the costs of electric distribution, transmission, capacity, and taxes, surcharges, and fees. This approach has no material impact on the comparison between charging costs on hourly-and flat-rate energy pricing, but it does mean that it would not be 'apples to apples' to compare the fuel costs above with the gasoline cost needed to power a traditional internal combustion vehicle.

Second, as stated previously, our model is an optimization analysis that assumes a perfectly rational charging strategy, where EVs are charged only the minimum number of hours needed to meet daily driving needs and are charged at the lowest-cost times. This is an idealized assumption, and a difficult strategy to implement flawlessly even in a world with increased automation.

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[18] As a PHEV, the Prius Prime has a significantly smaller battery; for daily driving amounts above the electric only range it was assumed the battery was fully depleted.

Nevertheless, the data reveals ample opportunity for savings even under sub-optimal conditions. More than 88 percent of the hours in 2018 were below Ameren's flat-rate energy price, and 60 percent of the total hours were less than 3 cents/kWh.

Finally, while the total dollar amount of savings through hourly pricing (maximum $220) is small in comparison to the fuel-cost savings achieved simply by switching from an internal combustion engine vehicle to an EV, this analysis does not take into account the substantial grid and environmental benefits inherent in price-responsive demand when targeted at reducing peaks and improving load shape.

The fact that optimized hourly pricing cut EV charging bills by at least 50 percent without consideration of these additional benefits strongly indicates that dynamic pricing can play a key role in maximizing social welfare.

Conclusion

Transportation electrification presents a rare opportunity for all stakeholders affected by electricity regulatory policy to benefit. The right set of policies can help achieve the traditional regulatory goals of safe, reliable, and affordable service while advancing system efficiency, enhancing environmental sustainability, and facilitating the integration of distributed energy resources.

If the goal is to "charge for less," dynamic pricing is essential to EV charging.

But to achieve these aims, we need to ensure that EVs charge at the most optimal times for the power grid. While there are other possibilities, and while multiple approaches may be needed, using price signals to manage charging is one of the best (and cheapest) strategies.

Time-based rates are effective at incentivizing EV owners to charge their vehicles when it will not burden the utility system.[19] And as this analysis shows, they also provide a route for EV drivers to unlock savings at the same time. For these reasons, we recommend that policymakers implement opt-out dynamic pricing for EV charging.

One rate structure is usually applied to all usage in a home, but it need not be in the case of electric vehicles, as the chargers (and/or cars) have sophisticated sensor and data-analysis capabilities. Although we generally believe that the risks of dynamic pricing—and the concomitant benefits of traditional, average utility rates—are overstated, separately calculating EV charging costs can be a boon to adoption by customers who may fear having all their household usage priced under time-variant rates.[20]

Because it is vital that regulatory policy get out ahead of transportation electrification to maximize consumer and environmental value, we do not want to see opt-out dynamic rates for EV charging stalled because of controversies surrounding whole-home dynamic pricing.

Will EV-only, opt-out time-variant rates also prove controversial? Perhaps. But it is worth noting that none of the arguments typically made against dynamic pricing apply in the case of electric vehicles.

Consider, for example, the claim that dynamic pricing is problematic because not all consumers can respond to price signals.[21] EVs are simply different than other appliances because:

- they have batteries;
- battery capacity means even heavy drivers do not need to charge very often;
- the charging process itself can be easily scheduled through automation;
- EV operating costs can be reduced significantly by charging in low-cost hours.

In fact, electric vehicles have the ideal type of load and load shape for dynamic pricing, from both an individual owner and a societal welfare point of view. For these reasons, it is critical to utilize this kind of rate design.

Automated charging has the potential to further expand the base of customers who could realize these benefits when combined with machine learning. Moving from the retrospective optimization model, which relies on perfect pricing information, to a model that employs pricing algorithms to make charging decisions would allow EV owners to put this strategy into practice using a "set it and forget it" approach.

This would make the potential of realizing the full cost-savings accessible to all customers. Further research into optimized charging models should incorporate pricing models with the option to utilize strategies such as inter-day price arbitrage, skipping a day of charging, or even selling energy power as be-

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[19] See, e.g., http://www.utilitydive.com/news/how-pepco-isfinding-ways-to-shift-demand-through-maryland-ev-pilot-program/434156

[20] See Zethmayr, Jeff and David Kolata. 2018. The costs and benefits of real-time pricing: An empirical investigation into consumer bills using hourly energy data and pricing. The Electricity Journal 31 (2018) 50–57

[21] Like, e.g., on a hot summer day when they are home and simply need the air conditioner to run.

hind-the-meter generation, should a particular day's LMPs exceed expected levels.

This discussion raises the question of whether a time-of-use (TOU) or hourly-pricing rate structure is preferable. Our view is that either can work and that the primary issue is getting as many EVs as possible on time-variant rates aimed at ensuring charging occurs when it is most advantageous for consumers, the grid, and the environment.

That having been said, as transportation electrifies and there are millions of EVs on the road, hourly pricing may prove the better alternative. To maximize the public interest, we will want to incorporate distribution system and environmental attributes in price signals and also be prepared to respond rapidly when (and if) the peak starts to change.

Charging at night in Illinois because of wind – or during the day in California because of the duck curve[22] – is an easy rule-of-thumb now, but that may change as EV deployment scales. The inherent flexibility of hourly pricing provides an advantage over administratively set TOU rates. Thus, we recommend that hourly pricing be offered as an alternative for all EV drivers, even in states where policymakers choose an opt-out TOU structure.

Transportation electrification is in its infancy, but the wheels are beginning to pick up speed and are unlikely to stop. To preserve this momentum, stay current with the evolving market, and ensure that it delivers system benefits requires proactive regulatory policies. Opt-out dynamic pricing must be one of those tools.

We encourage all states to seize the moment and open proceedings as soon as possible to start moving in this direction, as there are many logistical and strategic implementation questions to answer. For example, will states need to reconsider 'meter grade' billing requirements and other potential regulatory hurdles? It is possible.

Also, should third parties, such as a pharmacy or shopping center, be able to offer charging rates that differ from the dynamic rate? We think the answer is probably yes, provided the third party (or an entity it has a business relationship with) pays the actual time variant-price.

But there are many complex questions involved here and it's important that they be carefully considered in a stakeholder process. In the final analysis, if the goal is to "charge for less" in both the economic and environmental sense of the term, it is imperative that dynamic pricing is required of EV drivers.

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[22] See Fast Facts: What the duck curve tells us about managing a green grid, California Independent System Operator, 2016. https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

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CUB is Illinois' leading nonprofit utility watchdog organization. Created by the Illinois Legislature, CUB opened its doors in 1984 to represent the interests of residential and small-business utility customers. Learn more at **CitizensUtilityBoard.org**.