Smart Electric Power Alliance

Utilities and Electric Vehicles

EVOLVING TO UNLOCK GRID VALUE

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ABOUT SEPA

SEPA facilitates collaboration across the electric power industry to enable the smart deployment and integration of clean energy resources. Our focus centers on solar, storage, demand response, electric vehicles, grid management, and other enabling technologies.

DISCLAIMER

SEPA does not claim that this report is entirely complete and may be unintentionally missing information. SEPA advises readers to perform necessary due diligence before making decisions using this content. Please contact SEPA at research@sepapower.org to provide additional information.

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Special thanks goes to our electric vehicle research intern, Anshul Saxena, who thoroughly collected this research over a three-month period. His exhaustive and detailed research yielded a dataset we are proud to share in this report. We also appreciate the time and contributions of SEPA's Electric Vehicle Working Group, particularly recognizing the Rocky Mountain Institute, ICF, Maui Electric, Trico Electric Cooperative, Exelon, City of Palo Alto Utilities, Madison Gas & Electric, San Diego Gas & Electric, Rocky Mountain Power, Dominion Virginia Power, and Oklahoma Gas & Electric for their review of the utility EV datasets.

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METHODOLOGY

Utility electric vehicle information was collected by SEPA through online research, including utility websites, reports, utility filings, press releases, journal articles, and other publicly-accessible information. Data was also collected from SEPA's Electric Vehicle Working Group members. Information was collected between July 2017 and October 2017 from the 486 utilities included in SEPA's Utility Database (the database retired in November 2017). The data was cross-checked and validated by the working group and other external reviewers. This information covers EV programs and activities accessible to about 70% of all electric retail, commercial, and industrial customers in the United States. The resulting report is intended only as a snapshot of utility activity; it does not include discontinued programs and activities or those initiated after October 2017. Nor is it comprehensive; some programs and activities were not discoverable through online research.

Data on state regulations related to EVs was gathered between November and December 2017 drawing on the Advanced Energy Economy's PowerSuite platform and public utility commission websites. A single docket often included multiple programs and activities. In such instances, dockets were categorized to align with the latest version of the open docket or the final order if the docket was closed. A docket was defined as closed if an order had been issued on the filing, regardless of whether additional information was required following the order (e.g., annual reports), or if the docket had been merged with another proceeding. Further, because this research included only filings from public utility regulatory commissions, the findings include only investor-owned utilities.

Additional utility-level detail is available to SEPA members and can be found at www.sepapower.org in the Knowledge Center. Members may also request more specific information about the data, or provide corrections, by sending an email with a specific request through data@sepapower.org. For more information about SEPA's EV research and activities, go to https://sepapower.org/electricvehicles/.

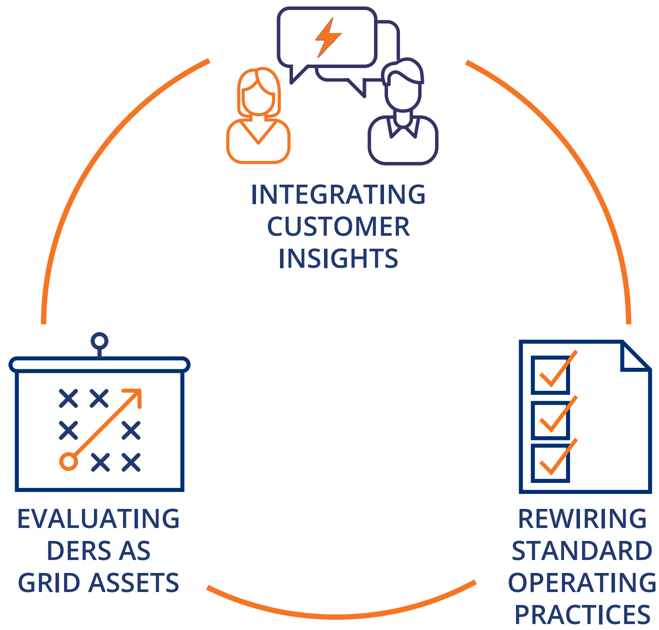
Foreword

Over the past several years, questions have arisen surrounding the role of electric utilities in the growing electric vehicle (EV) market. As regulators make critical decisions in the coming years, they should be mindful of the central role utilities will play to minimize the potential grid impacts of this new load and increase access to important charging infrastructure.

Utilities have proven their ability to adapt and innovate to handle new challenges. For example, many utilities today have demand response programs that minimize system peaks caused by air conditioning on hot summer days or heating on cold winter nights. Similarly, we would anticipate utilities will respond to a large concentration of EVs that may be simultaneously charging on-peak. However, that ability to innovate and respond to those conditions will take time and the ability to test new strategies.

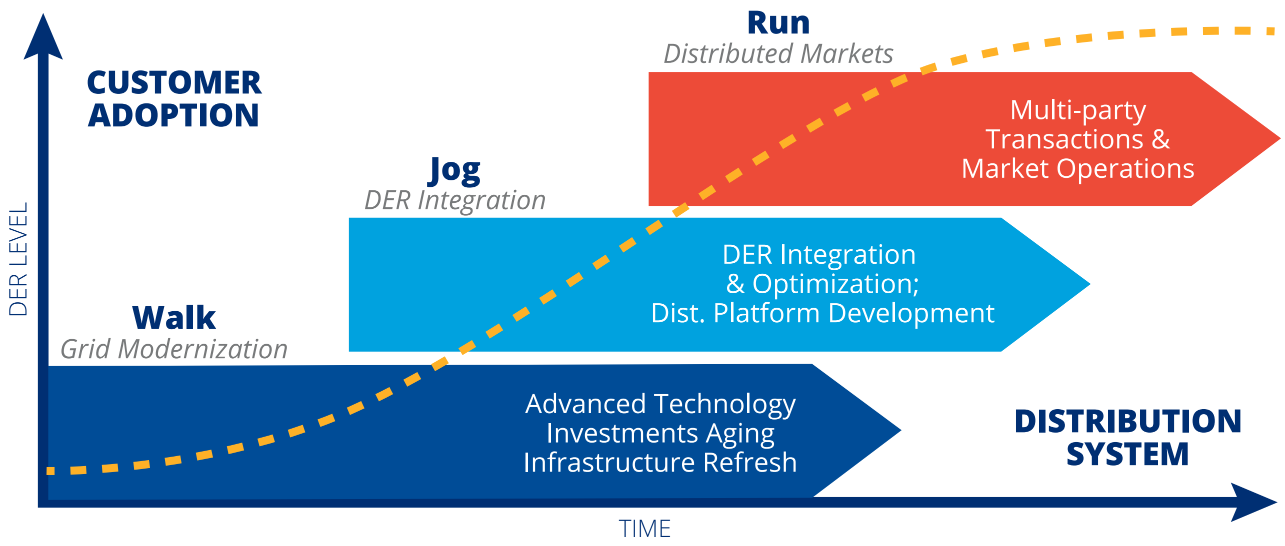
Based on numerous and continuously revised EV forecasts, time is not on the utilities' side. Forecasts increasingly predict exponential growth over a fairly narrow span of time. Many unknowns about the technology will also play a major role in EV planning; for example, which charging model—quick or longer duration charging—will ultimately prevail.

Further, many utilities do not want to just serve this new load—they want to take advantage of EVs as a distributed energy resource (DER) with the ability to modulate charge (i.e., managed charging), or even dispatch energy back into the grid (i.e., vehicle-to-grid). As noted throughout SEPA's Beyond the Meter series, utilities need to understand and leverage distributed energy assets, including EVs, as grid assets to allow for greater penetration of renewable energy—among many other benefits.



Source: Smart Electric Power Alliance, 2016. *Beyond the Meter: The Potential for a New Customer-Grid Dynamic.*

THE WALK-JOG-RUN FRAMEWORK



Source: GridWorks, Planning for More Distributed Energy Resources on the Grid, 2016.[1]

This paper captures this progression in utilities' EV programs and activities through a fairly simple framework, from early stage to intermediate to late stage, identifying specific benchmarks at each point in the process. The framework is similar to GridWorks' Walk-Jog-Run Framework[2] for DER integration, with the same basic message: a utility cannot run before it has learned to walk.

Each step of the process is requisite to an end state in which EVs are part of the fully connected, highly integrated, and transactive grid of the future. SEPA does not suggest that any one stage is more important than the next, or how quickly a utility should transition between stages. We fully recognize that each utility is different, and such decisions will largely be determined by the local market and regulatory conditions. However, each utility should have a strategy to define how and when they will respond to this technology.

We hope you find the report useful for your own work and look forward to your feedback. If you are a SEPA member, we encourage you to join our Electric Vehicle Working Group[3] to participate in the conversation.

Erika H. Myers
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Smart Electric Power Alliance

1 GridWorks, https://gridworks.org/wp-content/uploads/2018/01/plug-and-play-report_online_v2.pdf.

2 Formerly known as MoreThanSmart

3 https://sepapower.org/community/member-committees-and-working-groups/electric-vehicle-working-group

Executive Summary

Utilities have generally taken a conservative approach to electric vehicle (EV) deployment, despite forecasts that EVs' annual energy consumption will rise from a few terawatt-hours (TWh) a year in 2017 to at least 118 TWh[4] and potentially as high as 733 TWh[5] by 2030. According to SEPA research, many utilities may be caught unprepared. While many utilities across the country have expressed an interest in growing load, they are also uncertain about the most effective approaches to ensure benefits for consumers and address concerns of regulators and other governance boards.

UTILITIES ARE EXPLORING OPTIONS

The growth in EV sales and the resulting potential for charging patterns to shift has raised a number of questions. While fewer instances of impacts from EV clustering or "timer peaks" related to time-of-use rates[6] exist today, future growth may substantially impact the distribution system. As the electrification of the transportation sector evolves beyond traditional models of individual ownership of light-duty vehicles to more heavy-duty EV fleet applications, issues could become even more amplified.

In order to address these, and other concerns, utilities have begun to explore EVs and charging technologies and experiment with or implement new programs and activities. Based on a survey of 486 utilities representing about 70% of total U.S. customer accounts spanning the U.S., SEPA grouped these efforts into three stages: Early, Intermediate, and Late.

Early Stage: These utilities are experimenting and exploring EV options to educate utility staff and customers.

Intermediate Stage: These utilities have external-facing EV activities and programs in place.

Late Stage: These utilities are actively engaged with customers and leveraging EVs as a grid asset.

Part I of this report includes the results of the SEPA survey, providing a snapshot of EV activities and programs to date. Part II contains an analysis of regulatory filings related to EV programs and tariffs between 2010 and 2017. The conclusion provides recommendations on how utilities could more quickly transition between stages and the suggested next steps they might take.

MUCH WORK TO BE DONE

As shown in the figure below, the vast majority of utilities surveyed—roughly 75%—were in the Early Stage. The need here is for a massive ramp-up with Intermediate and Late Stage utilities transfering expertise to the Early Stage organizations.

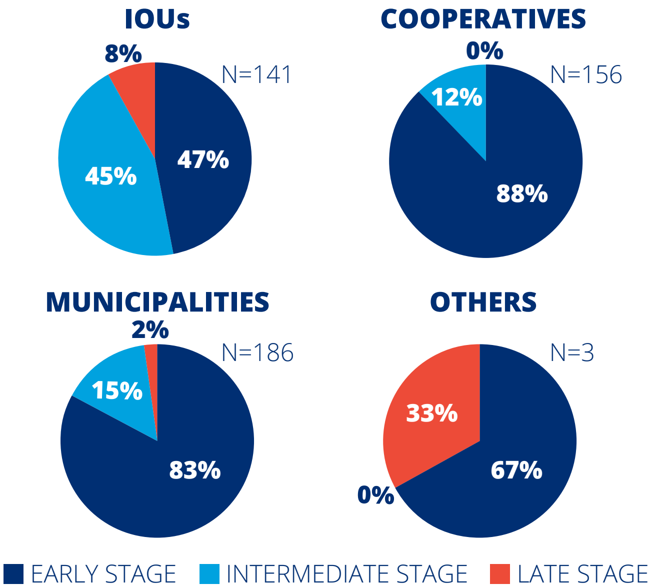
Further, the survey revealed a correlation between a utility's stage and ownership type. The vast majority of Late Stage and Intermediate Stage utilities are represented by Investor-Owned Utilities (IOUs).

4 Bloomberg New Energy Finance, July 2017, Long-Term Electric Vehicle Outlook 2017, Figure 59.

5 RethinkX, 2017, *Rethinking Transportation 2020-2030*, https://www.rethinkx.com/.

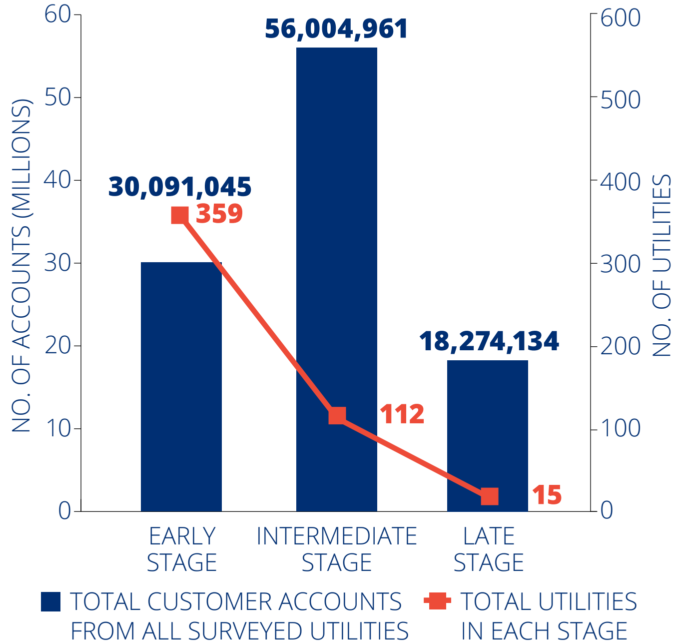
6 These issues discussed at length in SEPA's, *Utilities & Electric Vehicles: The case for managed charging* report, April 2017.

PERCENT OF UTILITIES BY STAGE AND BY UTILITY TYPE



Source: Smart Electric Power Alliance, 2018. N=486. "Other" includes federal and state utilities.

TOTAL NUMBER OF UTILITIES BY STAGE AND BY CUSTOMER ACCOUNTS

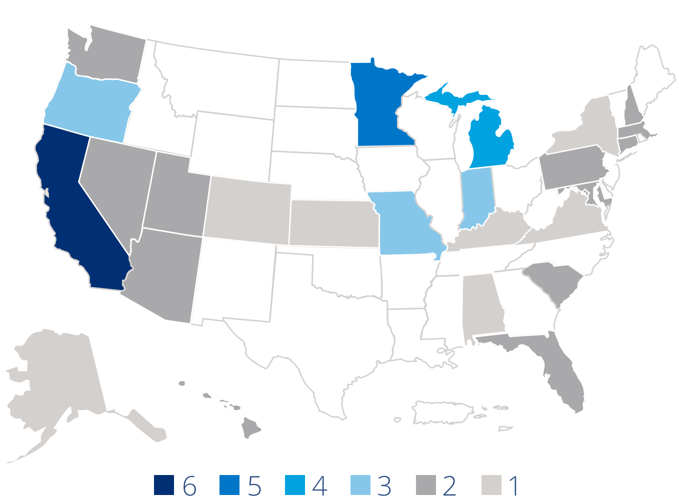


Source: Smart Electric Power Alliance, 2018.

EV REGULATION IS DISPERSED AND UNEVEN

EV regulatory filings tend to be clustered in certain states and regions, as shown in the figure below. The states with higher numbers of filings either have a high number of existing EVs, have signed a zero-emission vehicle memorandum of understanding,[7] or have supported EVs either through incentives or other policies. Regulatory uncertainty also makes replicating programs between utility service territories more challenging—clearly defining and understanding the utility role in the development of EV initiatives could help reduce such constraints.

TOTAL NUMBER OF EV-RELATED REGULATORY DOCKETS BY STATE



Source: Smart Electric Power Alliance, 2017. Note: Dockets identified through AEE PowerSuite (https://powersuite.aee.net) search of relevant EV dockets between November-December 2017.

7 See https://www.zevstates.us/ for details.

THE WAY FORWARD

Given the rapidly evolving EV landscape, how can a utility best position itself and its customers for an EV future? Peer exchange and collaboration will be crucial at this stage in EV deployment. In particular, information should be disseminated from areas with high EV penetration to emerging markets. Late Stage utilities with best practices and refined business models could share them with Early Stage utilities to accelerate the rollout process, from standard demonstrations to full-scale business models.

Given the potential for a steep EV sales curve, utilities should consider the following steps to avoid major issues in the future (discussed further in the conclusion):

- Individually develop a robust EV strategy that best aligns with customer interests, regulatory and policy environment, risk appetite, and ultimate goals for the technology
- Help build consensus and agreement among stakeholders around the utility's role in transportation electrification and charger deployment
- Mitigate EV grid impacts
- Collaborate with other utilities to reduce the time and costs associated with starting up new programs
- Collaborate with the broader industry.

Utilities and other industry partners have many opportunities to engage with SEPA on these and other important topics. Utilities should proactively evaluate choices for strategic planning around EVs, including the consideration of infrastructure, customer engagement, and other elements of EV deployment and utility operation assessments. While utilities may not see high penetrations of EVs in their service territories today, it's time to start planning for tomorrow.

NOTE TO THE READER

This report is intended to help electric utilities and regulators understand the current landscape of utility-led EV programs and activities.

A utility's EV progress usually requires experimentation, learning, and refinement of its programs to best suit the needs of the customer, current and forecasted volume of EVs in their service territory, the regulatory and policy environment, business model strategies, and risk appetite of the utility.

The stages define a trajectory for the utility that might help inform business models and strategies the utility could adopt with the ultimate goal of integrating EVs as a distributed energy resource asset to increase clean energy integration and minimize risks. SEPA does not take a position on what programs or activities are preferable, how those programs are deployed, or when they are deployed. Each utility should determine what parameters work best for them and on what timeline, be it months, years, or even decades.

Introduction

Utilities have generally taken a conservative approach to electric vehicle (EV)[8] deployment, despite forecasts that EVs' annual energy consumption will rise from a few terawatt-hours (TWh) a year in 2017 to at least 118 TWh[9] and potentially as high as 733 TWh[10] by 2030—equivalent to the average annual consumption of 9 million to 68 million U.S. homes.[11] According to SEPA research, many utilities may be caught unprepared, and few are ready to take full advantage of this new load.

In some states, utilities have been relatively more active with EV development as a response to regulatory or policy activity. Washington, Oregon, and California[12] have all enacted legislation encouraging utilities to file applications for charging infrastructure with their public utility commissions. In 2015, California also enacted SB 350, which instructed the California Public Utilities Commission (CPUC) to direct the six in-state investor-owned utilities (IOUs) to submit programs that "accelerate widespread transportation electrification" to meet state goals.[13] Minnesota required all public utilities to file an EV tariff with the commission.[14]

However, no state has mandated that utilities be directly responsible for EV or EV infrastructure deployment in the way they are for other distributed technologies, like renewable energy, energy efficiency, energy storage, or demand response. Further, while many utilities are interested in the opportunity for EVs, few have finalized a strategic plan for EV engagement.

This report defines three stages of transportation electrification development:

- **Early:** Utilities in this stage are becoming aware of the opportunity for transportation electrification, but have taken little action. This stage is characterized by assessing EV market penetration and analyzing potential grid impacts at different penetration levels. These utilities have frequently eased into the technology through their utility EV fleet acquisitions, fleet or workplace charging for employees, and educational content on the company website.
- **Intermediate:** Utilities in this stage have decided and/or have been prompted by regulators to take a more proactive role in transportation electrification. These utilities have generated information to better plan for EV deployment. They have also developed and implemented programs ranging from vehicle and charging equipment incentives, to special EV charging rates, to public or workplace charging equipment rollouts. These utilities have also considered charging technology and point-of-sale payment standards to incorporate into the utility programs.

8 For purposes of this report, electric vehicles include plug-in electric vehicles (comprised of plug-in hybrid electric and battery-electric vehicles).

9 Bloomberg New Energy Finance, July 2017, Long-Term Electric Vehicle Outlook 2017, Figure 59.

10 RethinkX, 2017, *Rethinking Transportation 2020-2030*, https://www.rethinkx.com/.

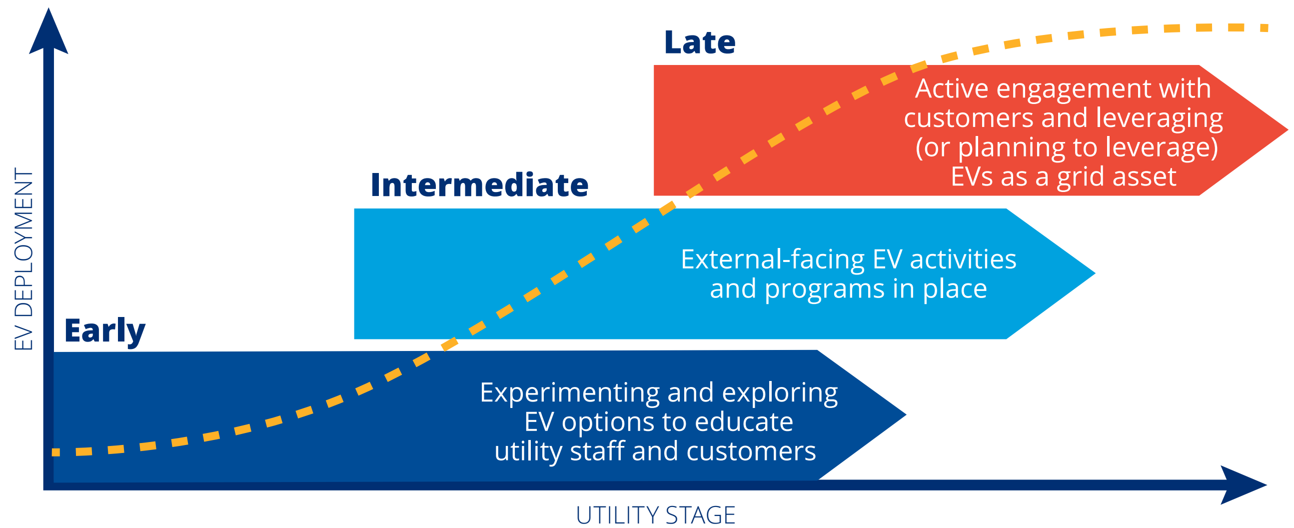
11 In 2016, the average annual electricity consumption for a U.S. residential utility customer was 10,766 kWh according to the U.S. Energy Information Administration. EIA estimates EVs will consume 54 TWh in 2030 (https://www.eia.gov/outlooks/aeo/data/browser/#/?id=47-AEO2018&cases=ref2018&sourcekey=0).

12 Washington ESHB, 2015; Oregon Senate Bill 1547, 2015; California Senate Bill 350, 2015.

13 For a copy of the legislation and a list of current CPUC activities to comply with SB 350, see http://www.cpuc.ca.gov/sb350te/.

14 Minnesota Statute 216B.1614 requires that, by February 1, 2015, "each public utility selling electricity at retail must file with the commission a tariff that allows a customer to purchase electricity solely for the purpose of recharging an electric vehicle."

FIGURE 1: UTILITY STAGES FOR EV INTEGRATION



Source: Smart Electric Power Alliance, 2018.

- **Late:** These utilities are actively engaged with their EV customers and are considered leaders by their peers. They have developed long-term, strategic goals for transportation electrification and have aligned their approach to state policies established by the legislature and public utility commission (if applicable). They have also initiated managed charging or vehicle-to-grid pilot programs that could eventually lead to full-scale implementation and are potentially considering the broader value of EVs as a grid balancing resource.

As discussed in SEPA's other reports, including the *Beyond the Meter* series,[15] SEPA's ultimate goal with EVs, or any other behind-the-meter technology, is to fully leverage the technology as a grid asset to improve grid reliability and efficiency. As shown in Figure 1, each utility stage includes certain levels of EV engagement that may overlap with the volume of EVs within the service territory.

Part I of the report includes the results of a utility survey to provide a snapshot of EV activities and programs to date. Part II includes an analysis of utility EV regulatory filings between 2010 and 2017. The conclusion includes recommendations of how utilities could more quickly transition between stages and suggested next steps.

THE ROLE OF THE ELECTRIC UTILITY AND THE ELECTRIC VEHICLE REVOLUTION

As EV adoption rates continue to increase alongside growing government policy support, utilities will play an increasingly important role in the EV market as the fuel provider, platform for charging infrastructure, charging standards development leader, and consumer educator.

This is a pivotal time for EVs. In 2017 and 2018, we witnessed a litany of major automotive manufacturer commitments to expand or transition completely to EVs. Britain, France, Norway, and India announced goals to eventually ban internal combustion engines (ICEs), and other countries, including Germany and China, are

15 See www.sepapower.org Knowledge Center for links to these reports.

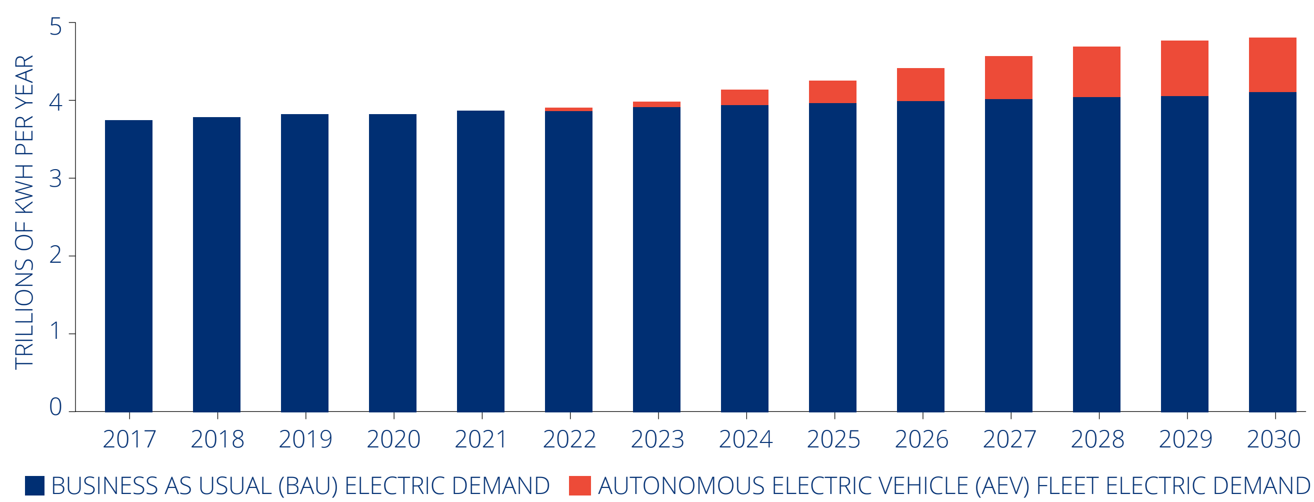
THE IMPACT OF A SHARED, AUTONOMOUS, AND ELECTRIC VEHICLE FUTURE

A May 2017 RethinkX report, *Rethinking Transportation 2020-2030*, envisioned a significant transportation disruption through the deployment of shared, autonomous, and electric vehicles (also known as SAEVs) that will be owned by fleets, not individuals, in a business model coined transportation-as-a-service, or TaaS.[16] The report's authors predicted that due to the potential savings from TaaS—projected to be four to ten times cheaper per mile than buying a new car—95% of passenger miles will be via TaaS within 10 years of widespread regulatory approval of autonomous vehicles.[17]

Concurrently, with this rollout, authors predicted that electricity demand will increase by 18% compared to the business-as-usual (BAU) case. They estimate that TaaS use will result in 733 billion kilowatt-hours (kWh) of electricity consumption in 2030, but that the capacity could be met with existing infrastructure by timing the charging for off-peak periods.

While existing capacity across the country could meet this load, TaaS demand and usage patterns are still unclear. How consumers will ultimately use the technology could be very different from the current ownership model, in which vehicles are parked 95% of the time. It is also unclear what sort of charging model TaaS fleets will use. For example, demand could be locally concentrated in central autonomous vehicle "hubs" for quick charging, creating strains on distribution infrastructure. Significant opportunities and challenges lie ahead for electric utilities and other industries as they attempt to plan around this emerging disruptive technology, which could have vast impacts depending on how quickly and widely it is adopted.

FIGURE 2: TAAS AS A SHARE OF TOTAL U.S. ELECTRICITY DEMAND



Source: RethinkX, 2017, *Rethinking Transportation 2020-2030*, https://www.rethinkx.com/

16 Others in the industry refer to this as shared, autonomous electric vehicles (SAEVs) or simply connected autonomous vehicles (CAVs).

17 While it is difficult to predict when that widespread approval will occur, Congress introduced legislation in 2017 to streamline the federal regulatory approval process for autonomous vehicles.

also considering future bans.[18] Nearly every major forecasting firm has increased its EV penetration forecasts, including Bloomberg, DNV-GL, and Navigant. As lithium-ion battery prices continue to fall, forecasters are now predicting that EVs will reach cost-parity with ICEs sooner than previously expected. Other quickly evolving trends, such as autonomous vehicles, could further accelerate EV adoption and completely alter the current transportation model.

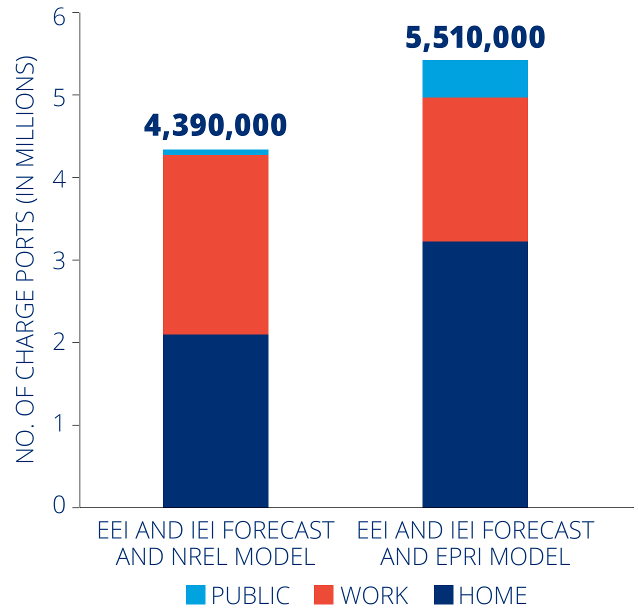
Forecasts suggest a major EV charger rollout will be necessary to meet demand. According to a 2017 report by the Edison Electric Institute (EEI) and the Institute for Electric Innovation (IEI), the number of EVs on the road will increase from 567,000 at the end of 2016 to 7 million by 2025, representing approximately 3% of total registered vehicles.[19] To support this deployment, approximately 4.5 to 5.5 million charging ports would need to be installed by 2025.[20] EEI and IEI estimate that 50,000 to 70,000 charging ports were available in 2017 in public locations and workplaces (not including home charging).[21] Navigant estimates the total number of installed charging ports (including home charging) in the U.S. at the end of 2017 at approximately 475,000.[22]

While the majority of these ports will be at home and workplace locations, publicly available infrastructure will also be critical. EEI and IEI contend that utilities are well-positioned to help develop and support home, workplace, and public EV charging infrastructure, and to effectively integrate EV charging loads onto the distribution grid.

Moving forward, charging needs and behaviors may change as EV batteries continue to increase vehicle range and charging technologies become more powerful. Questions include: Will workplace charging continue to play an important role for charging needs? Will home charging lean more towards Level 2 versus Level 1 as more 200-mile EVs become available? To what degree will DC fast chargers support the needs of public access charging? To what degree will SAEVs impact charging needs and in what timeframe? Should utilities collaborate with traditional (e.g., charging industry) and/or nontraditional (e.g., convenience store owners or automotive manufacturers) partners to solve infrastructure access challenges?

While this paper doesn't begin to address those questions, more research is needed to understand how driver requirements may change—and how utilities can support those needs in the future.

FIGURE 3: EV CHARGING PORTS REQUIRED BY 2025 (BASED ON EEI AND IEI EV FORECAST AND NREL AND EPRI CHARGE PORTS ESTIMATES)



Source: EEI and IEI, 2017.

18 CNN, September 2017, http://money.cnn.com/2017/09/11/autos/countries-banning-diesel-gas-cars/index.html

19 EEI and IEI, July 2017, Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required, http://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20PEV%20Sales%20and%20Infrastructure%20thru%202025_FINAL%20(2).pdf

20 Ibid. Note that charging ports are not the same as the total number of stations. Typically public chargers have two ports.

21 EEI and IEI, July 2017, Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required; U.S. Department of Energy, Alternative Fuels Data Center. http://www.afdc.energy.gov/fuels/stations_counts.html. UBS Presentation, January 9, 2017.

22 Navigant Research, Market Data: Electric Vehicle Charging Equipment, Table 3.7, published 2Q 2017.

EV RESEARCH KEY FINDINGS

We found many utilities in our survey were still in early stages of EV planning and activity. While our survey did not explore why this might be the case, anecdotal evidence from SEPA's EV working group and other industry experts points to several factors, including:

- Limited internal support and other strategic priorities;
- Limited understanding of the technology and its impact on the grid;
- Lack of clarity on the potential impact of EVs in a particular service territory;
- Low EV penetration to date;
- Uncertainty about the utility role in EV deployment; and
- Uncertainty around regulatory approval of utility-owned charging infrastructure in the asset base.

While many utilities are interested in growing load, they are anxious to identify an approach that will benefit consumers while addressing concerns of regulators and governance boards. Applying lessons learned from distributed solar, utilities should get engaged at the beginning of the EV transition to:

- Mitigate grid impacts by encouraging better charging habits;
- Identify optimal charging locations;
- Employ smart charging infrastructure to balance grid operations and provide additional value to both customers and charging site hosts;
- Ensure appropriate charging accessibility for all customers; and
- Other reasons as discussed in the conclusion.

Part 1: Utility EV Programs and Activities

For the purpose of this report, we opted to identify three stages of transportation electrification development, as shown in Table 1: Early, Intermediate, and Late. Characteristics for each stage were identified (see pg. 17 for details) and grouped. Though we realize these characteristics are not comprehensive, this study was limited to using publicly accessible information. For example, while it would be good to know how a utility might be engaging in EV codes and standards development, that information is typically not posted on a website. Likewise, it would be difficult to know how a utility might be educating staff internally on the topic through staff training, conference attendance, or via consultants.

For purposes of the analysis, a utility was considered Early if it only had activities or programs in the early stage, or no identified activities or programs at all. A utility was considered Intermediate if it had at least one activity or program in the Intermediate Stage, regardless of Early Stage activity. A utility was considered Late if it had at least one activity or program in the Late Stage, regardless of any activity in the Early or Intermediate Stage.

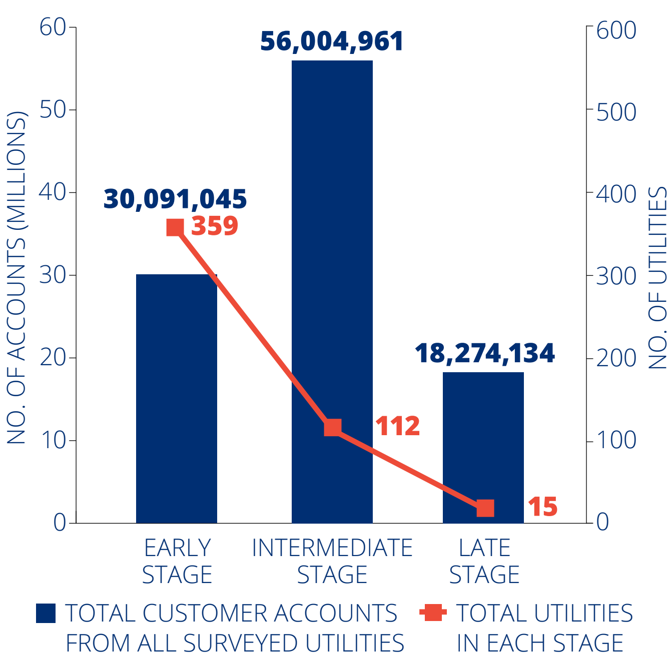
As shown in Figure 4, the vast majority of utilities—74%—were in the Early Stage, with 23% in the Intermediate Stage, and the remaining 3% in Late. A disproportionate number of customer accounts are in the Late Stage utilities,

TABLE 1: STAGES OF UTILITY EV ACTIVITY OR PROGRAM DEVELOPMENT

EARLY STAGE	INTERMEDIATE STAGE	LATE STAGE
Utilities in this stage are becoming aware of the opportunity for transportation electrification, but have taken little action. This stage is characterized by assessing EV market penetration and analyzing potential grid impacts at different penetration levels. These utilities have frequently eased into the technology through their utility EV fleet acquisitions, fleet or workplace charging for employees, and educational content on the company website.	Utilities in this stage have decided and/or have been prompted by regulators to take a more proactive role in transportation electrification. These utilities have generated information to better plan for EV deployment. They have also developed and implemented programs ranging from vehicle and charging equipment incentives, to special EV charging rates, to public or workplace charging equipment rollouts. These utilities have also considered charging technology and point-of-sale payment standards to incorporate into the utility programs.	These utilities are actively engaged with their EV customers and are considered leaders by their peers. They have developed long-term, strategic goals for transportation electrification and have aligned their approach to state policies established by the legislature and public utility commission (if applicable). They have also initiated managed charging or vehicle-to-grid pilot programs that could eventually lead to full-scale implementation and are potentially considering the broader value of EVs as a grid balancing resource.

Source: Smart Electric Power Alliance, 2018.

FIGURE 4: TOTAL NUMBER OF UTILITIES BY STAGE AND BY CUSTOMER ACCOUNTS



Source: Smart Electric Power Alliance, 2018.

at 1.2 million average customer accounts per utility. Intermediate Stage utilities follow with an average of 500,000 customer accounts per utility, followed by 83,800 customers per Early Stage utility, meaning smaller utilities are those largely in the Intermediate and Early stages.

SEPA generated this utility EV program and activity dataset through online research and information shared by SEPA's Electric Vehicle Working Group members. Information was collected between July 2017 through October 2017 for 486 utilities representing about 70% of total U.S. customer accounts and spanning all 50 states and the District of Columbia.[23]

23 The data was cross-checked and validated by SEPA's Electric Vehicle Working Group and other external reviewers. While this dataset was not intended to be comprehensive, it does provide a snapshot of utility activity. The data does not include retired programs or programs/activities that were not discoverable through online research.

MUCH WORK TO BE DONE

These results indicate a need for a massive amount of ramp-up that would potentially be supported by Intermediate and Late Stage utilities transfering expertise to the Early Stage utilities. Significant work has been done, for example, on EV time-of-use (TOU) rates. This knowledge could be collected and applied to service territories without existing rates.

That said, a large amount of research on other topics could be developed through utility-to-utility exchange and collaboration. Rather than attempt to tackle such a large challenge within the sphere of a single utility, the industry should consider taking a more unified approach. A collaborative approach would maximize time and value, prevent duplication of effort, and enable faster development of business models and plans based on results in other service territories.

Utilities have much to learn from each other that can help them quickly transition from one stage to the next. It may be difficult to duplicate efforts exactly from one utility territory to the next due to variations in the availability of charging infrastructure, types of driver trips, local climate conditions, local regulation, cost parameters, and regulatory requirements—to name a few. But to the extent that a program design can be standardized, streamlined, more cost-effective, and more easily localized across the country, significant efficiencies could be gained.

VEHICLE-TO-GRID TECHNOLOGY CHALLENGES

Vehicle-to-grid (V2G) dispatch uses a plugged-in EV with available charged battery capacity to feed power back to the grid. V2G can potentially provide services to the grid in exchange for financial compensation to the vehicle owner.

SEPA identified two active V2G pilots: Pacific Gas & Electric's pilot with BMW and Maui Electric's JUMPSmartMaui pilot with Hitachi and Nissan Leaf owners (discussed later in the report). SEPA also identified two open dockets considering V2G projects, including a demonstration project with Nissan at Portland General Electric. As of the report publication date, SEPA was aware of at least two other V2G pilot projects in development, but not yet formally announced.

While still in the early stages, V2G may have the potential to provide significant value for utilities and balancing authorities if technical barriers can be overcome. The University of Delaware's Center for Carbon Free Power Integration has developed a large body of research on V2G and sponsored a number of pilot projects.[24] Other groups, such as the California Public Utility Commission's Vehicle Grid Integration (VGI) Communication Protocol Working Group, are assessing how and whether the adoption of a communication protocol is necessary to enable VGI resources, such as V2G, to economically participate in electricity markets at scale.

Despite this work, V2G is still more conceptual than commercial. While V2G technology is likely to develop over time, it will require additional elements for widespread adoption. These elements include approval/consent of vehicle manufacturers so as to not invalidate warranties and usage guidelines,[25] additional hardware expense for AC/DC[26] conversion and control, and interconnection permits and engineering/technical requirements of local grid operators/utilities.

24 More information at http://www1.udel.edu/V2G/.

25 At the date of publication, no vehicle manufacturers provide a warranty for V2G activities due to concerns about battery life and safety.

26 AC = alternating current, DC = direct current.

UTILITY STAGE PROGRAMS AND ACTIVITIES

Below are the utility programs and activities used to define each utility stage:

EARLY STAGE

- **Utility EV fleet:** Owns and operates electric vehicles, including plug-in hybrid electric, battery electric, or advanced hybrids, such as hybrid bucket trucks.
- **Workplace charging for utility fleet and/or employees:** Provides access to charging stations at a few or all of the office locations or fleet locations, including those stations that were part of a pilot program for utility assessment.
- **EV content on utility website or dedicated website:** Provides general information about EVs, such as EV rates and EVSE permitting and installation practices. EV outreach and query contact information, or information about utility EV initiatives and activities, were also included.

INTERMEDIATE STAGE

- **EV incentives:** Utility-based cash rebates or utility bill credit rebates for the purchase of an EV for residential (1) and commercial (1) classes.
- **Electric Vehicle Supply Equipment (EVSE)[27] incentives:** Utility-based cash rebate, utility bill credit rebate, reduced installation or purchase cost incentives for EV charging equipment for residential (1) and commercial (1) classes.
- **Special EV rates:** Utility rate for EV charging equipment or whole-house rate with EV charging equipment. May or may not require installation of a separate meter (submeter) for any customer class. Also includes rates that are part of a pilot program.
- **Charging station installation for public use:** Utility-aided installations for public charging with no restriction to access the charging station.
- **Workplace charging (installations at partner locations):** Utility-aided installations at locations which could help a commercial or non-commercial entity in promoting EV adoption. Access to these charging stations is usually restricted and for employees only, but can be accessible to the public during a pilot or an outreach program.
- **EV customer engagement through utility pilots and outreach:** Includes pilot TOU rate structures or distribution system assessment pilots primarily intended to collect customer usage data for planning purposes, such as EV clustering in a service territory. Also includes active customer outreach in the form of Ride-and-Drive events hosted by utilities for the public or interested parties.

LATE STAGE

- **Managed charging pilot/demonstration:** Utility-led pilot or demonstration program to manage the charging capabilities of EV charging stations in its service territory, either directly or through a partnership.
- **Vehicle-to-grid (V2G) pilot/demonstration:** Utility-led pilot or demonstration program to implement a V2G demonstration by enabling two-way power flows between an EV and the grid. Also includes vehicle-to-home (V2H) pilots.
- **Full-implementation of managed charging or V2G:** Full-scale utility-led managed charging or V2G program. (At the time of the survey, no utilities met this criteria.)

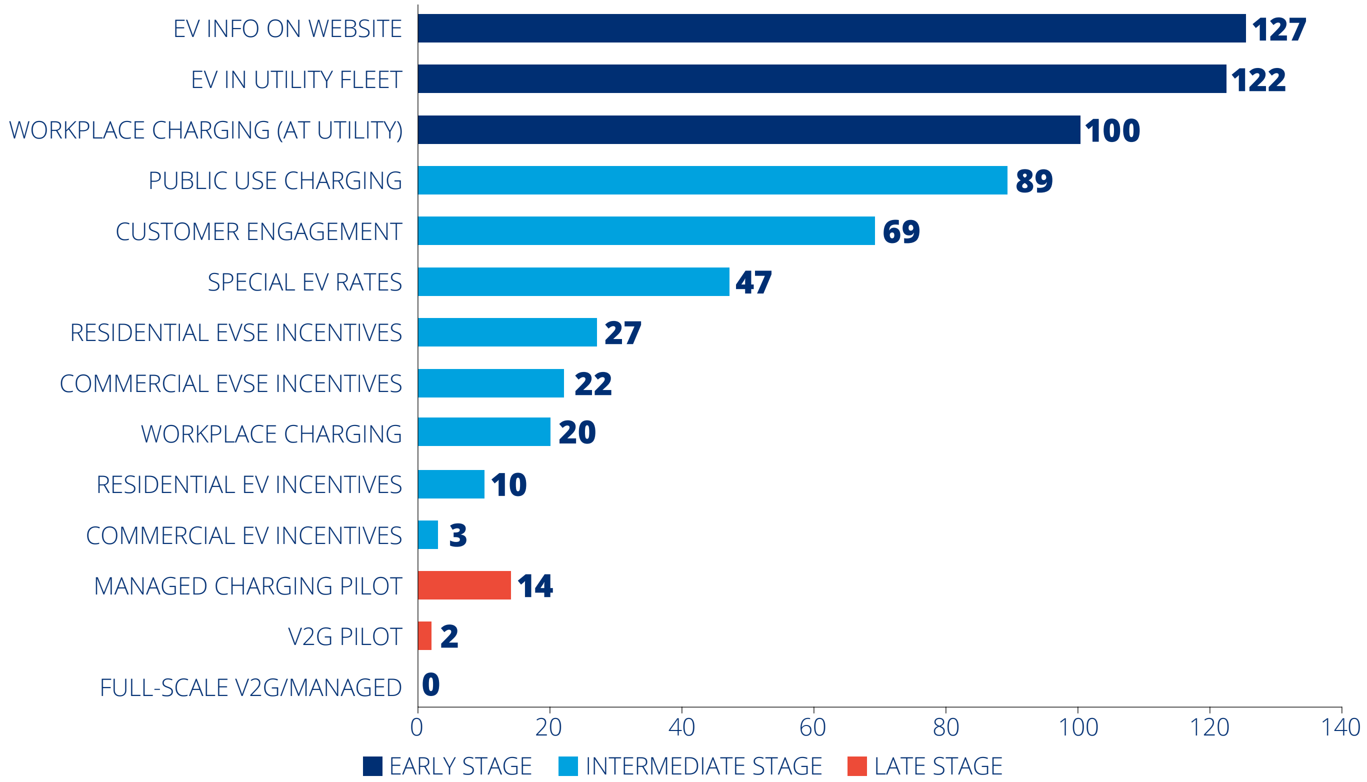
27 EVSE refers to all components between the panel and the charger connector

FINDINGS

SEPA found active utility engagement across all utility types and geographic locations. The vast majority of activity was in the Early Stage. As shown in Figure 5, the frequency of programs and activities declined with each subsequent stage. The most popular Early Stage activity was providing EV information on a utility website. Given the relatively limited work required to develop website content, it was notable that only 25% of the surveyed utilities engaged in this activity. The most popular Intermediate Stage activity was utility-led public-use charging infrastructure. Many of these charging ports were free of charge as part of a public education and awareness effort. The most popular Late Stage activity was a managed charging pilot that allowed utilities to test the efficacy of charging and communication technologies to modulate charging events.

We found a noticeable relationship between utility types and the corresponding stages. Of the 15 Late Stage utilities identified, nearly all (11) were IOUs. Further, of the 359 Early Stage utilities, 302 had no identified activity at all; 267 of those represented municipalities and electric cooperatives, as shown in Figure 6. Table 2 includes short summaries of utility activity within each stage to provide additional context.

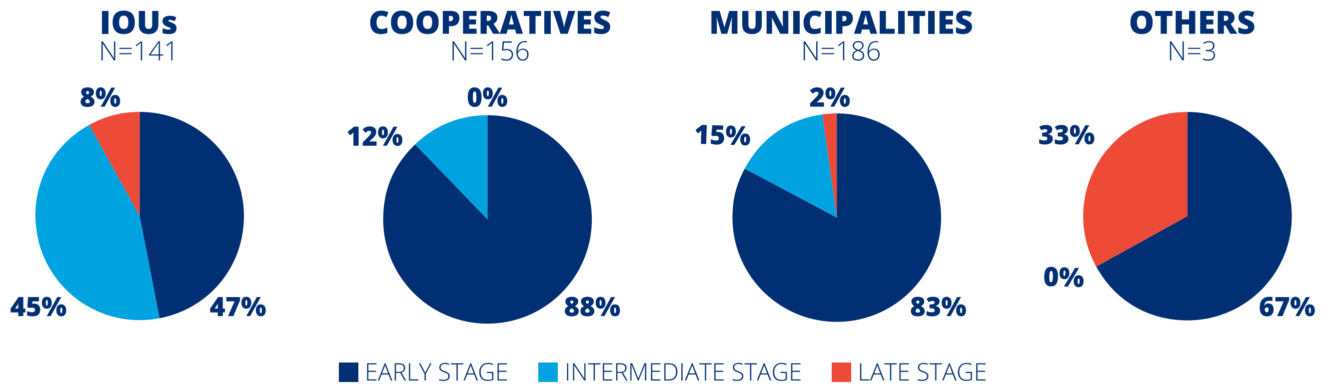
FIGURE 5: UTILITY EV ACTIVITIES AND PROGRAMS BY TYPE AND STAGE



Source: Smart Electric Power Alliance, 2018; N=486.

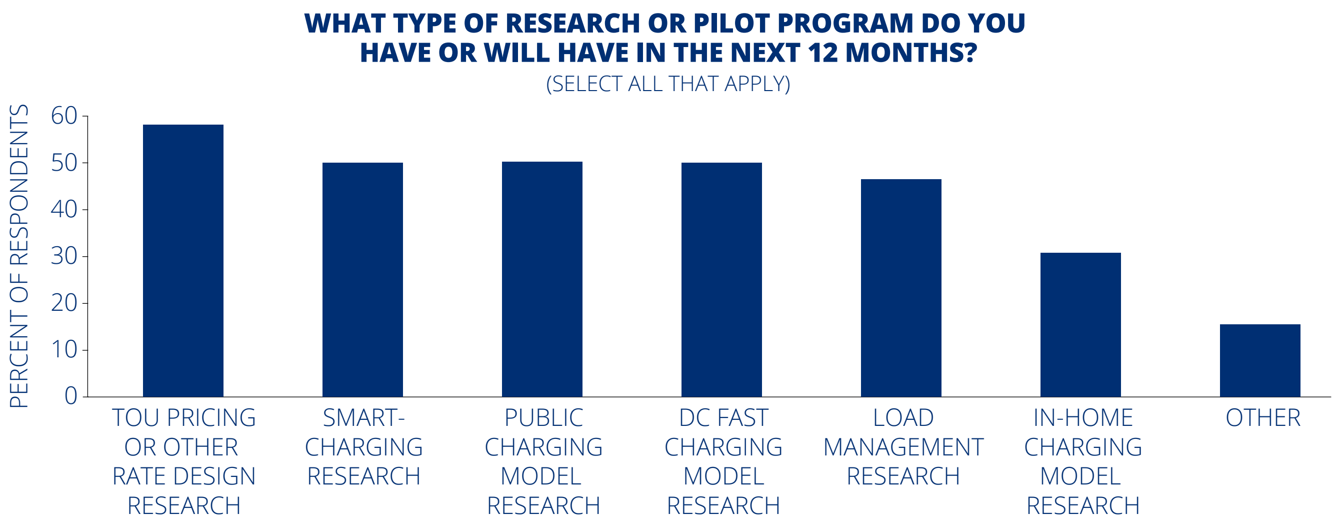
Utility interest in managing EV load is growing. Based on a survey conducted by Deloitte and supported by SEPA in the third quarter of 2017, many utilities will be conducting research over the next year on a wide range of Intermediate and Late stage technologies. Nearly 50% of the 34 utilities participating in the survey said they would be researching load management strategies and smart charging (also known as managed charging), as shown in Figure 7.

FIGURE 6: PERCENT OF UTILITIES BY STAGE AND BY UTILITY TYPE



Source: Smart Electric Power Alliance, 2018. N=486. "Other" includes federal and state utilities.

FIGURE 7: INTERMEDIATE AND LATE STAGE RESEARCH ACTIVITIES



Source: Deloitte, Utility Electric Vehicle Survey, 2017, N=34

TABLE 2: UTILITY EXAMPLES	
EARLY STAGE	
FLORIDA POWER & LIGHT, FLORIDA	Florida Power & Light (FPL) made investments in its utility fleet vehicles and charging infrastructure and has educational website content. FPL is committed to providing affordable, clean, reliable energy to more than 10 million Floridians. The company operates one of the largest clean vehicle fleets in the nation as part of its continued focus on efficient technologies that help reduce air emissions, lower fuel consumption and keep customers' bills low. In 2006, FPL became the first energy company in the nation to place a medium-duty hybrid-electric bucket truck in service. Today, its clean vehicle fleet includes 1,849 biodiesel-powered vehicles and 493 electric and hybrid-electric vehicles, which use up to 60% less fuel and reduce exhaust emissions up to 90%. In 2016 alone, FPL saved 693,707 gallons of petroleum fuel and prevented more than 6,715 tons of carbon dioxide emissions.[28] FPL promotes the use of EVs for its company, employees, and customers. To help advance the adoption of clean driving technology in Florida, the company participates in events and offers information on its website: FPL.com/EV, where customers can learn more about EV benefits, charging requirements, workplace charging, and public charging options. FPL offers employee workplace charging at many of its facilities, including its clean energy centers, service centers, and office and administrative buildings. At its headquarters in Juno Beach, charging is located under solar PV canopies.
TAMPA ELECTRIC COMPANY, FLORIDA	Tampa Electric has similarly invested in their utility fleet and charging infrastructure. In early 2018, the Tampa utility will take delivery of five new plug-in electric Ford F-150 pickups from XL Hybrids. The plug-in pickups join the company's growing electric fleet consisting of several Nissan Leafs, full-size plug-in Chevy pickup trucks modified by VIA Motors, Chevy Volts, and a Cadillac ELR.[29] Aside from a website that includes resources for types of EVs, charging options, links to U.S. Department of Energy cost calculators and a map with charging infrastructure locations,[30] Tampa Electric is the first electric utility in the country that will offer an innovative energy education program focused on teaching high school driver's education students about electric vehicle technology.[31]

28 Information provided by FPL in February 2018.

29 http://www.tampaelectric.com/company/electricvehicles/ourgreenfleet/

30 http://www.tampaelectric.com/company/electricvehicles/

31 Information provided by Tampa Electric in February 2018.

TABLE 2: UTILITY EXAMPLES, CONTINUED	
INTERMEDIATE STAGE	
BRAINTREE ELECTRIC LIGHT DEPARTMENT, MASSACHUSETTS	Through its Braintree Drives Electric program, Braintree Electric Light Department encourages customers to attend EV workshops, test drive cars, and acquire EVs. The utility offers customers an $8 monthly credit, the equivalent of about 175 free miles, for charging at off-peak times. Advanced smart meters help the utility collect data on charging patterns and enable the utility to verify customers are charging during off-peak times. Braintree also offers a $250 rebate for purchasing a Level 2 charger. Additionally, Braintree has installed public charging stations and is leasing EVs for its own fleet.[32]
NEW HAMPSHIRE ELECTRIC COOPERATIVE (NHEC), NEW HAMPSHIRE	NHEC offers its residential customers a rebate of up to $1,000 on leased and purchased EVs. NHEC also offers incentives for businesses that install Level 2 or higher charging stations, and has installed three charging stations for employees at its Plymouth campus.[33]
GEORGIA POWER, GEORGIA	Georgia Power has shown significant activity in promoting and supporting EV customers by providing residential and commercial rebates for charging infrastructure, building a statewide DC fast charging network, and offering whole house TOU rates for EV owners that offer Off-Peak and Super-Off-Peak charging times. Through their infrastructure programs, the utility has incentivized over 1,300 commercial business chargers, 1,000 residential chargers and built a network of 37 public "Community DC Fast Charging Islands" across the state. Core to all their customer offerings is a "Get Current. Drive Electric™" media awareness campaign to help customers make the best informed decisions. Georgia Power has also incorporated EVs into their fleet, and provides workplace charging for its employees.[34]
WRIGHT-HENNEPIN ELECTRIC COOPERATIVE, MINNESOTA	This utility offers residential customers two pricing options for charging EVs at home. Customers can choose between a TOU program and a Storage Charge program. The Storage Charge program lets customers charge during off-peak hours and sets the energy rate at $.054 per kWh for that time. For the TOU program, the charging circuit runs through the meter to accurately track the car's charging, and charges the customers according to the time of charging. Members can switch between programs; however, each program uses different metering equipment and members will incur additional costs to switch. Wright-Hennepin also offers incentives for the installation of Level 2 chargers and has built two public charging stations.[35]

32 http://www.braintreedriveselectric.com/ and Braintree email communication in February 2018.

33 https://www.nhec.com/drive-electric/ and NHEC email communication in February 2018.

34 Information provided by Georgia Power email communication in February 2018.

35 http://www.whe.org/energy-savings-rebates/residential-programs-and-rebates/savings-on-electric-vehicle-charging.html and Wright-Hennepin email communication in February 2018.

TABLE 2: UTILITY EXAMPLES, CONTINUED	
LATE STAGE	
AUSTIN ENERGY (AE), TEXAS	This utility has demonstrated a significant commitment to support EVs and invest in infrastructure throughout the service territory. AE's innovative Plug-In Everywhere program offers customers unlimited charging for $4.17 per month to access more than 600 charging ports. The EV360 program offers unlimited at-home charging at off-peak hours and public charging for $30 per month. AE offers Level 2 charging rebates up to 50% for homes, work, retail, multifamily, and public spaces. AE is also committed to electrifying vehicles throughout the area, including over 300 City of Austin fleet vehicles and 30 electric buses in the local transit authority fleet by 2020. AE also managed two regional EV leadership and education grants from DOE, including the "Texas River Cities EV Initiative" and the "Central Texas Fuel Independence Project." AE launched the award-winning "Electric Drive Project," a sustainable transportation showcase, and, with help from the philanthropic 11th Hour Project, a low-income EV program known as "EVs are for EVeryone." Finally, with funding from a DOE ARPA-E grant, the utility successfully deployed an ongoing EV demand response pilot using OpenADR standards. AE is studying V2G feasibility as part of its DOE SHINES grant, and has helped publish Austin's Smart Mobility Roadmap to accelerate shared, electric, and autonomous transportation.[36]
SAN DIEGO GAS & ELECTRIC COMPANY (SDG&E), CALIFORNIA	SDG&E has shown a strong commitment to EVs through the Power Your Drive program[37] in which customers in apartments, condominiums, and workplaces have access to charging stations with an EV rate structure that reflects the hourly cost of electricity. Dynamic Hourly pricing is set the day before, and customers use a phone app to enter their preferences for maximum energy price or/and amount of hours to charge. Up to 3,500 Level 2 chargers will be installed through Power Your Drive, with over 300 ports installed as of January 2018. The utility also offers TOU rates for residential customers and annual bill credits for EV drivers/owners. Within its own fleet, the utility has over 125 EVs and electric power take-off vehicles and has installed over 250 chargers at its facilities. SDG&E received regulatory approval for six pilot programs which are in the process of being launched: a fleet delivery vehicle project with UPS and other delivery companies, a marine port project to electrify medium and heavy-duty vehicles and forklifts, a park and ride public charging project, an airport ground support equipment project, a green shuttle bus project and a dealership incentive to encourage point of sale education by car sales staff. In addition, a residential vehicle program is pending before the California Public Utilities Commission. If approved, the program will provide up to 90,000 Level 2 chargers to encourage managed charging and EV adoption. A final decision in the proceeding is expected in the first half of 2018. In January 2018, SDG&E submitted an infrastructure program to help electrify 3,100 medium-duty and heavy-duty electric trucks, buses and other commercial vehicles.

36 https://austinenergy.com/ae/about/environment/electric-vehicles and Austin Energy email communication in January 2018.

37 https://www.sdge.com/clean-energy/electric-vehicles/poweryourdrive and SDG&E email communication in January 2018.

TABLE 2: UTILITY EXAMPLES, CONTINUED	
LATE STAGE	
MAUI ELECTRIC, HAWAII	Maui Electric offers residential customers a discounted TOU rate from 9 a.m. to 5 p.m. when solar and other renewable energy options are readily available. This rate requires customers to install a separate meter at no cost to the customer. Additionally, commercial customers can qualify for a pilot rate program for EV public charging infrastructure on a TOU rate with a higher volumetric charge rather than a demand charge. The utility also owns and operates publicly accessible DC fast chargers, is collecting information for a workplace managed charging pilot, has incorporated EVs into its own fleet, and conducts customer outreach and education events. Through the JUMPSmartMaui pilot with Hitachi and Nissan Leaf owners, volunteer drivers were provided with EV-Power Conditioning Systems (EVPCS) in their homes. This Hitachi technology charged the vehicles during off-peak periods and discharged power to the volunteers' homes under a pilot rate of 1kWh. The purpose of this EVPCS system is to allow utility operators to manage EV charging to balance generation and power demand.[38]

LESSONS FROM THE FIELD: MINNESOTA'S EV TARIFF REQUIREMENTS

In 2014, Minnesota state legislation required each IOU to file an EV tariff with the Minnesota Public Utilities Commission (Commission).[39] In June 2015 the Commission approved these tariffs and required utilities to each file an annual report with the number of participating customers, amount of electricity sold under the tariff by peak period, development and promotional activities and costs, and other information. The June 2017 annual reports filed with the Commission indicate mixed participation levels—as shown in Table 3—and summarized in an October 2017 Order.[40] Each of these rates had a fixed monthly charge of $4.25 to $4.95, in addition to the volumetric charge listed.

Based on information provided by utilities and intervenors, there were concerns about utilities with a shorter off-peak charging window. Intervenors recommended expanding the window to accommodate more drivers. Intervenors also found that the secondary meter was a major deterrent and suggested that potentially replacing the second meter with a less expensive submeter could alleviate the initial upfront cost, which could range from $400 to $600 including materials and labor.[41] To minimize this issue, Xcel Energy - Minnesota submitted a request in November 2017 for an EV pilot that would eliminate the need for a secondary meter. If approved, the

38 https://www.mauielectric.com/clean-energy-hawaii/electric-vehicles and Maui Electric email communication in January 2018.

39 Minn. Stat.§ 216B.1614.

40 Minnesota Public Utilities Commission, October 26, 2017, Order Accepting 2017 Annual Reports and Establishing Requirements for Next Annual Reports, https://www.edockets.state.mn.us/EFiling.

41 Based on estimate provided by SEPA EV working group members; cost depends on location and meter type, and estimate of one to three hours of fully loaded labor. In contrast, according to testimony filed by Siemens in California, a submeter can be included in a charger for less than $50 in reasonable quantity purchases.

LESSONS FROM THE FIELD: MINNESOTA'S EV TARIFF REQUIREMENTS, CONTINUED

TABLE 3: TIME-OF-USE RATE RESULTS BY REGULATED UTILITY IN MINNESOTA (JUNE 2017)

	OFF-PEAK HOURS	OFF-PEAK PRICE (CENTS/ KWH)	ON-PEAK PRICE (CENTS/ KWH)	SECONDARY METER REQUIRED	# PARTICIPANTS	AMOUNT SPENT ON PROMOTION
MINNESOTA POWER	11pm-7am	4.332	On-peak charging not available	Yes	0	N/A
OTTER TAIL POWER	9pm-7am	Winter/ summer: 4.661/ 2.962	On-peak charging not available	Yes	2	$3,615
XCEL ENERGY - MINNESOTA	9pm-9am, holidays, weekends	3.3	Winter/ summer: 14.17/ 17.564	Yes	95	$106,000

Source: Smart Electric Power Alliance, 2018.

homes' existing meters would be replaced with equipment that could separately measure home energy usage and EV usage. The pilot would be available for 100 customers for two years.[42]

According to SEPA survey results, 45 active EV-specific TOU rate structures have been adopted around the country as a way to mitigate on-peak charging, but very few programs to date have yielded widespread uptake. For example, the Sacramento Municipal Utility District reported only about 30% of EV owners take advantage of the EV rate.[43] Low participation rates may be due in part to a smaller price differential between off-peak and on-peak charging, add-on costs to participate, off-peak charging times that don't overlap with the customer's need, or simply that the customer may not be aware of the EV rate.

As discussed in SEPA's 2017 *Utilities & Electric Vehicles: The case for managed charging* report, managed charging may work better than TOU rates, as it provides the ability to modulate charge time and power levels to correspond more quickly to peak hours or events. EV driver needs and preferences are still a critical consideration in any managed charging program design, although home charging can be more forgiving due to the long dwell time of most vehicles.

In Minnesota, as part of the aforementioned proceeding, all of the stakeholders recommended that utilities initiate managed charging pilot programs within their respective EV tariffs as a next step due to the limitations of the TOU rate and added costs of a secondary meter or submeter.

42 Xcel Energy, No. 17, 2017, Petition for Approval of a Residential EV Service Pilot Program, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7BD0E9CB5F-0000-CF14-9BCC-5EC9F3F41564%7D&documentTitle=201711-137482-01.

43 SEPA, 2017, *Utilities & Electric Vehicles: The case for managed charging*.

THE CASE FOR DEMAND CHARGE MANAGEMENT

In Rocky Mountain Institute's 2017 *From Gas to Grid* report, the authors argued that demand charges would need to be mitigated in the near term to allow for EV infrastructure providers to remain profitable until a higher penetration of EVs were on the road.[44] Hawaiian Electric Company, for example, established a DC fast charging (DCFC) tariff in late 2017 that only includes a volumetric rate.

However, these types of programs may not work for all utilities that need to accommodate a variety of usage patterns, distribution system upgrades, coincident versus non-coincident rate structures, and other unique challenges. One area in need of significantly more research is demand charge management, especially as the next generation of superchargers and heavy-duty vehicle technologies could require 350 kilowatts (kW) or more of demand for a single charging event.

To keep costs low for customers while still allowing utilities to recoup their investment, these management strategies could include everything from temporary to permanent demand charge alterations, software packages, or on-site equipment upgrades. While SEPA does not advocate for these, or any other options, a list of potential demand charge management solutions identified through numerous utility and industry interviews include:

- Recovering fixed costs through an increased volumetric charge;
- Providing EV drivers with market signals that relay real-time costs (e.g., gas station model) or the ability to throttle down the rate of charge at certain times of the day via the utility, aggregator, site operator, or other stakeholder;
- Altering demand charges for DCFC and Level 2 infrastructure at locations deemed optimal by a utility for a fixed period of time;
- Altering demand charges for a fixed period of time if a third party upgrades a line for a DCFC unit;
- Providing direct utility access over charging units to manage the load in exchange for demand charge cost reduction, similar to other commercial demand response programs;
- Installing demand charge limiting software in the DCFC units to cap charges on site;
- Adding a tariff to a volumetric rate for EV infrastructure that could fund a series of mobile batteries to deploy to strained distribution feeders, reducing costs for site operators;
- Using demand management tools, which would allow commercial customers to reduce loads once they hit a pre-set demand level;[45] or
- Using on-site energy storage and/or renewable energy.

These and other options will be explored in future SEPA publications—stay tuned!

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44 Rocky Mountain Institute, 2017, *From Gas to Grid: Building Charging Infrastructure to Power Electric Vehicle Demand*, https://www.rmi.org/wp-content/uploads/2017/10/RMI-From-Gas-To-Grid.pdf

45 An example includes the Landis+Gyr Demand Manager tool for residential applications.

Part 2: Utility EV Regulations

In addition to the utility survey, SEPA also generated an EV regulatory filings dataset spanning 2010 to 2017.[46] Several key themes emerged from the research:

- Utilities often included more than one type of program or activity as part of a more comprehensive approach to EV deployment;
- The majority of the programs were demonstration or pilot programs with an expiration date;
- Regulators required utilities to provide interim status reports, and regulators approved changes to refine a program or activity following the initial decision; and
- Few dockets involved activities in the Early Stage, such as utility fleet investments. The vast majority were activities or programs in the Intermediate or Late Stage, signifying a larger utility investment or more regulatory oversight.

In total, SEPA identified and analyzed 57 dockets including 44 utilities across 26 states and the District of Columbia. At least 15 other dockets with EV-related activities were identified, but not included in the final list. SEPA excluded these dockets because they had a very small or unclear impact on EV deployment, were withdrawn, were merged with another docket, or did not fit the parameters of the research. While not intended to be a comprehensive dataset, the list provides a snapshot of utility EV regulatory filings—both closed[47] and open—across the country.[48]

FINDINGS

As utilities initiate more EV programs, the total number of regulatory dockets has grown considerably in recent years, as shown in Figure 8. While nine dockets opened in 2016 had been closed by 2017, at the time of the survey, 13 cases were under review, meaning more decisions are likely in 2018.

The most common regulatory filings in the survey were for special EV rates, customer engagement efforts, and public and fleet charging infrastructure—in some cases owned or maintained by utilities directly. Though not included in Part I, SEPA included dockets that determined whether a state would allow third-party resale of electricity and the appropriateness of utility investment in EV infrastructure (discussed later in the report).

Based on the results, the regulatory process is solidly focused on activities and programs in the Intermediate Stage, reflecting the earlier trend highlighted in Part I. This means that utilities are still exploring and building their EV experience.

The significantly smaller number of Late Stage programs and activities means other utilities have had limited opportunity to replicate or build on findings from such programs.

46 Generated from an AEE PowerSuite search and via public utility commission websites.

47 A docket was defined as “closed” if an order had been issued on the filing, regardless of whether additional information was required following the order (e.g., annual reports) or the docket had been merged with another proceeding. Further, because this search included only public utility regulatory commissions, it primarily includes information from investor-owned utilities.

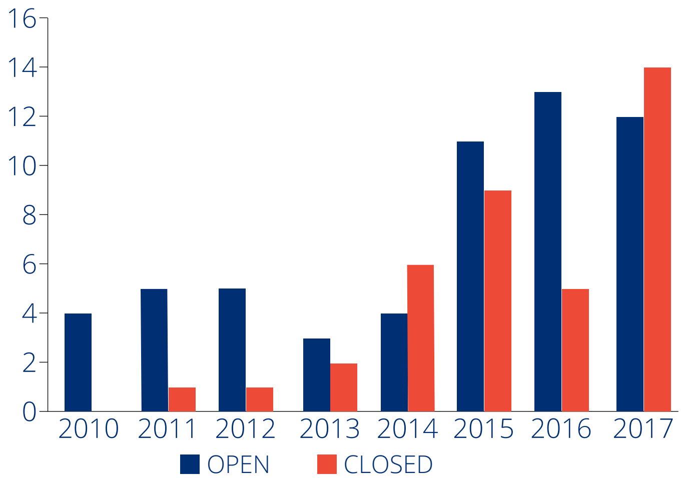
48 Of the 57 dockets analyzed, nine are Commission-specific or state-level decisions and do not involve specific utilities. Given the difficulty of knowing the status of those utility activities, the dataset may include some programs or activities that were retired or terminated. As part of the regulatory filing categorization process, all utility programs and activities within a docket were accounted for and adjusted if a final order had been issued.

Findings point to a utility pilot or demonstration project "cliff." No dockets identified in the review had requested full-scale implementation of managed charging or V2G. Likely reasons for this cliff include:

- Lack of reliable technology;
- Limited interoperability of the charging infrastructure;
- Limited deployment of vehicles in many utility territories;
- Lack of uniform industry standards; and
- Limited education or awareness of the technology by the regulatory community.

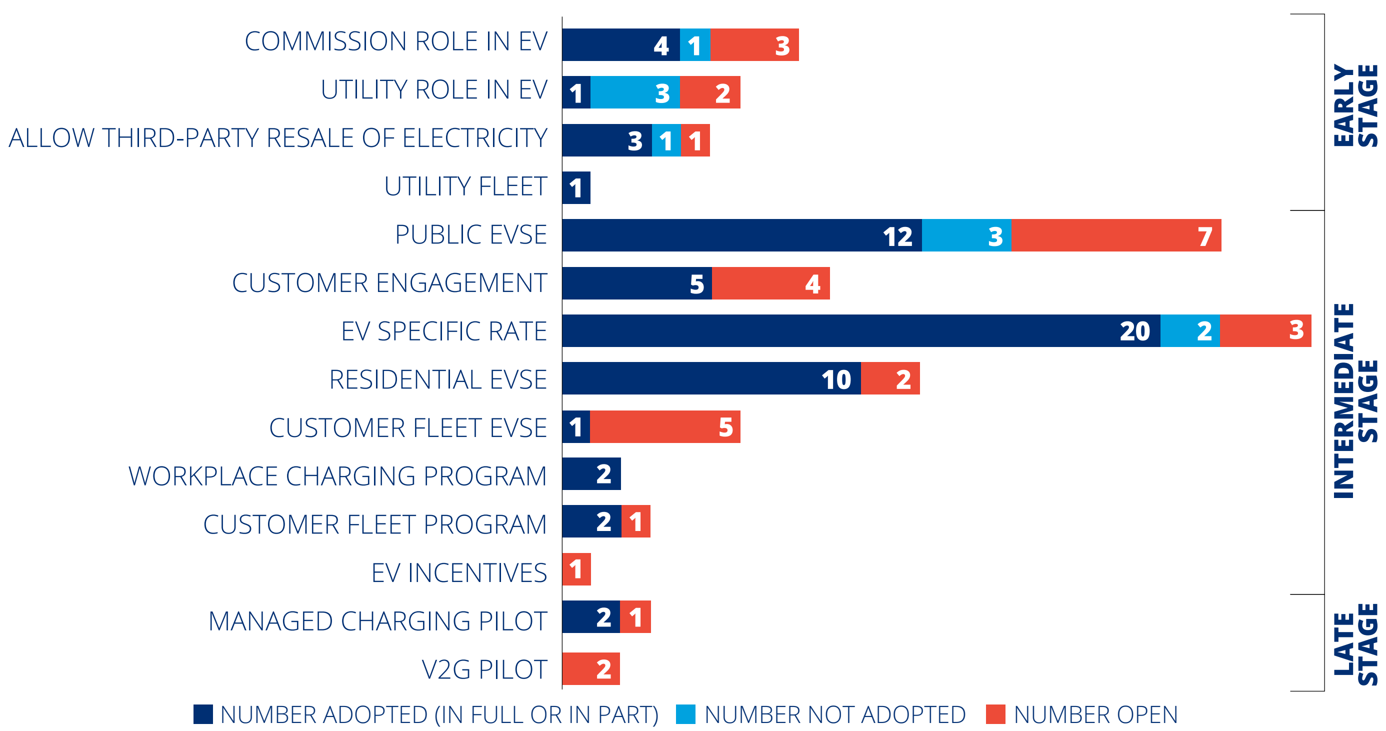
The regulatory community has an opportunity to show leadership in EVs by proposing and supporting projects that will help solve or overcome many of the aforementioned barriers. Further, proactive engagement with key stakeholders on

FIGURE 8: UTILITY REGULATORY DOCKET ACTIVITY BY YEAR (2010-2017)



Source: Smart Electric Power Alliance, 2017.
Note: Dockets identified through AEE PowerSuite (https://powersuite.aee.net) search of relevant EV dockets between November-December 2017.

FIGURE 9: UTILITY EV REGULATORY DOCKETS BY PROGRAM/ACTIVITY TYPE, BY STAGE, AND BY STATUS



Source: Smart Electric Power Alliance, 2017. Note: Dockets identified through AEE PowerSuite (https://powersuite.aee.net) search of relevant EV dockets between November-December 2017. SEPA categorized by program and/or activity. Some dockets include more than one type of program or activity so the total number is higher than the actual number of dockets.

the role of the utility in EV infrastructure deployment and associated programs, rates, and offerings can result in less contested regulatory proceedings to advance Late Stage objectives.

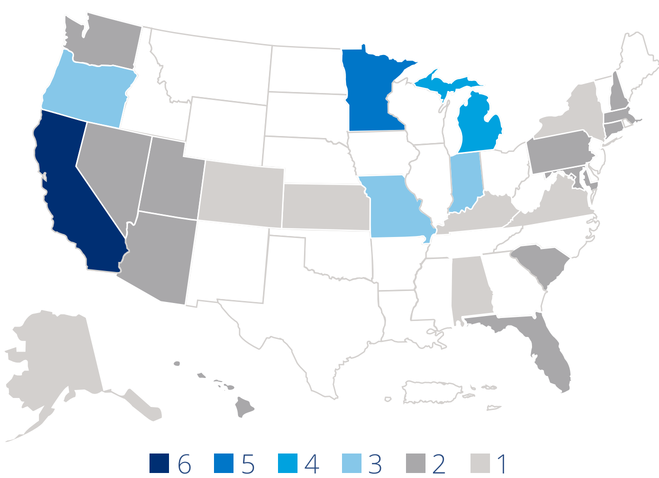
EV REGULATION IS DISPERSED AND UNEVEN

Our analysis shows that EV regulatory filings tend to cluster in certain states and regions, as shown in Figure 10. Filings largely overlap with states that have a high number of existing EVs, have signed a zero-emission vehicle memorandum of understanding, or have supported EVs either through incentives or other policies.[49] As shown in Figure 11, California had the largest volume of dockets, followed by Minnesota, Michigan, and a three-way tie with Indiana, Missouri, and Oregon. Many of these dockets were still pending, especially in California.

Of the 45 filings that were closed in December 2017, 28 had been approved in full (or with minor modifications), six had been approved with relatively significant changes, and seven had not been approved at all. Another four were not applicable to any kind of formal utility program as they were considering a question around the appropriateness of the commission or utility involvement in the electric vehicle market (or other questions). From these closed dockets we can learn a lot from the commission questions, intervenor concerns, and the roles of both the utilities and commissions in this rapidly evolving sector.

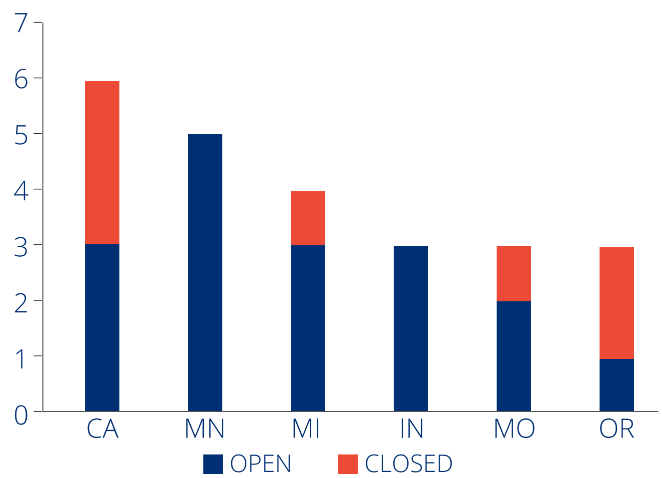
Of the utility dockets that were approved, some utilities included their EV plans as part of a larger rate case. For example, Gulf Power received approval in April 2017 to initiate a revenue-neutral public EV charging station pilot to install and maintain charging stations behind the electric meters of commercial customers. Payment agreements would be established with the requesting customers, such that all operation and maintenance expenses and other revenue requirements associated with the chargers would be recovered entirely by those customers.

FIGURE 10: TOTAL NUMBER OF EV-RELATED REGULATORY DOCKETS BY STATE



Source: Smart Electric Power Alliance, 2017. Note: Dockets identified through AEE PowerSuite (https://powersuite.aee.net) search of relevant EV dockets between November-December 2017.

FIGURE 11: TOP STATES BY DOCKET TOTAL (OPEN VS. CLOSED)



Source: Smart Electric Power Alliance, 2017. Note: Dockets identified through AEE PowerSuite (https://powersuite.aee.net) search of relevant EV dockets between November-December 2017.

49 See CleanTechnica and the DOE Alternative Fuels Data Center for details.

Gulf Power included just over $1 million for the chargers in the rate case and estimated a net operating income of $239,000 based on customer interest.[50]

Of the utility dockets that were partially approved, or significantly modified, Indianapolis Power and Light (IP&L) filed an alternative regulatory plan (ARP) with the Indiana Utility Regulatory Commission (IURC) in 2015, which ultimately led to a successful project. The ARP would cover the extension of distribution and service lines for approximately $3.7 million. It also included a request for an estimated $12.3 million for approximately 200 EV charging stations to be owned by a for-profit entity, known as BlueIndy, for a public charging and car-sharing program in Indianapolis, known as the BlueIndy Electric Car Share Program.

The reason the ARP was created was that the BlueIndy Project didn't meet the 30-month revenue test for the extension of distribution and service lines. The IURC approved up to $3 million for the distribution and service line extensions, but did not approve any costs for the infrastructure, ruling that those costs would directly benefit a for-profit entity and were not in the best interest of consumers.[51]

Despite not receiving the full requested amount, the project still moved forward. As of the latest regulatory filing in December 2016, IP&L reported a total of 80 EV car-sharing charging stations, with 400 charging ports and 282 vehicles in the program.[52] Since the launch, BlueIndy had enrolled 3,300 members and logged 41,000 rides with more sites under construction. IP&L at that time had spent just under $1 million for distribution and service line extensions. Additionally, 128 EV charging members were enrolled to connect personal vehicles to the BlueIndy charging network.

Finally, an example of a filing that was not approved was for a special EV TOU rate that was deemed unnecessary at the time. In June 2017, after Connecticut's state legislature asked the Public Utilities Regulatory Authority (PURA) to consider and determine if it was appropriate to implement EV time-of-day (TOD) rates for residential and commercial customers,[53] PURA decided that special EV rates were unnecessary. Two in-state utilities, Connecticut Light and Power (CL&P) and the United Illuminating (UI) Company, already offered TOD rates for residential and commercial customers that would allow drivers to shift their charging times and save money. Further, CL&P estimated it would cost $580,000 and take eight months to implement a new EV-specific TOD rate; UI estimated it would cost between $400,000 and $600,000 due to new metering configurations and added costs. While many of the intervenors agreed that current rates could work, some suggested modifications to the existing rates, such as making seasonal adjustments and improving the price differential between on and off-peak charges (e.g., CL&P is only 3.5 cents/kWh difference for residential TOD Rate 7) to further incentivize off-peak charging.[54]

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50 FL: 20160186, Petition for Rate Increase by Gulf Power Company, October 12, 2016, see Order No. PSC-17-0099-PHO-EI, http://www.floridapsc.com/.

51 Indiana Utility Regulatory Commission, Dec. 29, 2016, Cause No. 44478: Order of the Commission, http://www.in.gov/iurc/.

52 Indiana Utility Regulatory Commission, Dec. 29, 2016, Submission of Compliance Filing: IURC Cause No. 44478: BlueIndy Electric Car Share Program Annual Report, http://www.in.gov/iurc/.

53 Public Act 16-135, 2017, An Act Concerning Electric and Fuel Cell Electric Vehicles.

54 Public Utilities Regulatory Authority, June 9, 2017, Docket No. 16-07-2116-07-21, Final Decision, http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/850a1a72aead83c785257ff1004df3c2?OpenDocument

REGULATORY JURISDICTION OVER EV CHARGING INFRASTRUCTURE

One of the bigger, and more challenging, debates today in the DER community is over the right of regulated electric utilities to own and/or operate assets behind a customer meter, such as a "make-ready" site (i.e., all of the materials required up to the point of the charger) or charging station.

In California, the regulatory debate began in 2009 with a large focus on the utility role in mitigating the grid impacts of EVs. By 2013, California regulators decided that utilities could play a greater role to accelerate EV adoption and improve the business case of charging-station providers with behind-the-meter investments. Regulators approved corresponding pilots in 2016 and early 2018. Essentially, California regulators came to realize that vehicle-grid integration will be important when there is large-scale EV adoption, but a key first step is achieving large-scale EV adoption with a viable business case for all stakeholders.

Other states are still wrestling with this debate. In 2017, two regulatory commissions issued seemingly contradictory rulings around utility-owned EV infrastructure: Missouri and Massachusetts.

In April 2017, the Missouri Public Service Commission rejected a request by Ameren Missouri to install DC fast charging units. The commission ruled that the utility had not demonstrated that EV charging stations needed to be regulated to protect the public and that they did not have the jurisdiction to regulate utility-owned EV charging stations.[55]

It was a different story in Massachusetts. In November 2017, the Massachusetts Department of Public Utilities approved an Eversource Energy request to rate base approximately $45 million in public EV charging infrastructure upgrades to enable widespread deployment of public, workplace, and multi-unit dwelling residence chargers.[56] These "Eversource-side" investments were primarily for upgrades through distribution primary lateral service feeds, necessary transformer and transformer pads, new service meters, new service panels, and associated conduits and conductors to connect each piece of equipment. To approve cost recovery, the proposal had to meet the litmus test of being in the public interest, that is, meeting a need that was not likely to be met by the competitive EV charging market, and not hindering the development of the competitive EV charging market.

Two other regulatory commissions have recently approved utility-side investments in EV infrastructure. In November 2017, the Florida Public Service Commission approved a Duke Energy Florida settlement to allow the utility to own and operate an EV charging network with a minimum of 530 Level 2 and DC fast charger ports.[57] In 2016, the California Public Service Commission approved three EV charging pilots for Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison that would establish 12,500 new charging locations by 2020. These included SDG&E's aforementioned 3,500 Level 1 and Level 2 charge ports that they will install and own at multi-unit dwellings and workplaces.

Several commissions were reviewing the commission role in regulating the EV industry at the date of publication. For example:

- The Maryland Public Service Commission opened a proceeding in 2016 (later refined in 2017) to evaluate EVs as part of a larger effort to modernize Maryland's distribution system. Recommendations were submitted

55 https://www.efis.psc.mo.gov/mpsc/Filing_Submission/DocketSheet/docket_sheet.asp?caseno=ET-2016-0246&pagename=case_filing_submission_FList.asp

56 http://web1.env.state.ma.us/DPU/FileRoom//dockets/get/?number=17-05&edit=false

57 Details at http://www.floridapsc.com/ClerkOffice/ShowDocket?orderNum=PSC-2017-0451-AS-EU.

by commission-organized working groups on priority actions at the end of 2017.[58] A decision had not been made at the time of publication.

- Michigan's commission opened a docket in 2017 to understand its role in the adoption of EVs and infrastructure and receive public comment on whether or not it should conduct pilot projects.[59]
- In September 2017, the Missouri commission issued an order seeking comments on a variety of DER issues, including what distribution system upgrades would be needed to facilitate DER integration and what other actions might be needed to promote a competitive market for EVs. A report is expected in March 2018.[60]

Other commissions, such as the Washington Utilities and Transportation Commission, have been clearer about the role of the regulated electric utility and EV charging services. In June 2017, the Commission issued the following policy statement:

> *The Commission issues this policy and interpretive statement to clarify its jurisdiction and regulation of electric vehicle charging services offered by electrical companies. The Commission adopts policies supporting transformation of the electric vehicle (EV) market through utility provision of electric vehicle charging services, and a framework for regulating these services. Utilities may offer a portfolio of electric vehicle charging services on a regulated basis, consistent with Commission interests and policies promoting load management and system benefits, consumer protection, service quality, direct benefits to low-income customers, interoperability, stakeholder engagement, regular reporting, and education and outreach. The portfolio approach is also meant to support consumer choice, and allow a competitive market for these services to continue to develop. Finally, the Commission recognizes that utilities have access to information that will help align transportation electrification goals with electric system grid needs.*[61]

Regardless of the outcome for these, or other, regulatory decisions, it is important to reach consensus on the advantages of an electric utility role within a rapid transportation electrification scenario. These discussions will likely also be within the context of the evolving utility market, which is currently transforming from a regulated monopoly with enhanced services versus one as a platform provider for market players (as noted in the call-out box). SEPA's 51st State Initiative includes a wide variety of perspectives on this issue.[62] Many program design options can help utilities find an ideal EV role to satisfy grid needs, regulators, and stakeholders.

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58 http://webapp.psc.state.md.us/newIntranet/AdminDocket/CaseAction_new.cfm?CaseNumber=PC44

59 http://efile.mpsc.state.mi.us/efile/viewcase.php?casenum=18368

60 https://www.efis.psc.mo.gov/mpsc/Filing_Submission/DocketSheet/docket_sheet.asp?caseno=EW-2017-0245&pagename=case_filing_submission_FList.asp

61 Washington Utilities and Transportation Commission, Docket UE-160799, "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services," https://www.utc.wa.gov/docs/Pages/default.aspx.

62 See www.sepa51.org for more information.

PERSPECTIVE: THE UTILITY AS AN EV PLATFORM

The grid was traditionally designed to accommodate one-way power flows and large centralized generation assets. But to optimize the value to all customers, utilities will need to better incorporate two-way power flows and decentralized generation. Utilities as the Distribution System Operator are developing the grid and network as a platform to handle these two-way power flows and DERs, including EVs. According to Chris Budzynski, the Director of Utility Strategy for Exelon Corporation, utility planning and control of this platform will be key to its success and add value to all customers. The location of EV charging stations—regardless of who owns or operates them—will be important, because stations and EVs will help support the platform.

Exelon identifies three key trends that are now impacting many industries, including the utility sector: 1) technology innovation is accelerating, 2) data is exploding, and 3) everything is connected. All of these trends will drive greater customer value. Utilities are developing a platform model that is capable of supporting these trends and allows for transactions of services and solutions for customers to manage and optimize their energy use. According to Budzynski, this platform will allow for managed power flows at charging stations, leverage charging and usage data and provide new products and services. The utility developed platform can be both physical and electronic and will allow customer and other market participants to seamlessly buy and sell electricity and associated services.

Conclusion: The Way Forward

Given the rapidly evolving EV landscape, how can a utility best position itself and its customers for an EV future? Peer exchange and collaboration will be crucial at this stage in EV deployment. In particular, information should be transferred from areas with high EV penetration to emerging markets. Late Stage utilities with best practices and refined business models could share them with Early Stage utilities to leapfrog the standard demonstration to full-scale business model roll-outs.

Learning lessons from the distributed solar industry, we know that the adoption curve can ramp very quickly and catch a utility off guard. Given the potential for a steep EV sales curve, utilities should consider the following steps to avoid major issues in the future:

- Individually develop a robust EV strategy that works best for the customers, regulatory and policy environment, risk appetite, and ultimate goals for the technology;
- Help build consensus and agreement around the utility's role in transportation electrification and charger deployment;
- Mitigate EV grid impacts by:
  - encouraging better customer charging habits as soon as possible;
  - identifying optimal charging locations;
  - collecting and using EV data to plan and forecast distribution infrastructure needs;
  - deploying smart charging infrastructure to balance grid operations and provide additional value to the customer and charging site hosts;

- Collaborate with other utilities to maximize time and value by:
  - exchanging best practices to prevent duplication of effort;
  - quickly iterating and revising business models and plans based on results in other service territories;
  - supporting faster regulatory processes by using best-in-class research, pilots, and equipment deployments in similar service territories;
- Collaborate with the broader industry by:
  - agreeing on common standards for equipment interoperability and integration with existing smart grid platforms;
  - developing the necessary utility tools to ensure grid benefits and program design criteria that work for all stakeholders to reduce risk and speed up deployment;
  - defining and developing point-of-sale payment standards to expand charger access; and
  - ensuring proper charging access for all customers.

Building on that last bullet, for all utilities to be successful, data and communications standards, point-of-sale payment standards for all public charging infrastructure, and vehicle chargers with appropriate communications and metering capability are critical. The earlier such standards are defined and adopted, the more valuable and cost-effective the charging equipment will be.[63] Utilities should play a key role in this process and agree to these common technology standards to avoid risks of stranded assets.

In addition to directing standards development, utilities should coordinate across industries to obtain the data and information they need to appropriately plan and forecast. These collaborations could take many forms: from simple to sophisticated. And they should involve a range of stakeholders, including EV manufacturers, EVSE and technology providers, consumer and advocacy groups, and local and state government.

NEXT STEPS

The industry will need to research a wide range of issues in the coming years. While this report does not begin to address the questions listed below, SEPA strives to work with our industry partners to find answers to them.

- Will workplace charging continue to play an important role for charging needs?
- Will home charging lean more toward Level 2 versus Level 1 as more 200-mile EVs become available?
- To what degree will DC fast chargers support the needs of public access charging?
- To what degree will shared, autonomous, and electric vehicles impact charging needs—and in what timeframe?
- Should utilities collaborate with traditional (e.g., charging industry) and/or nontraditional (e.g., convenience store owners or automotive manufacturers) partners to solve infrastructure access challenges?
- How effective are EV TOU rates in controlling peak load? Are there superior alternatives, such as managed charging?
- What options are available for demand charge management to support a nascent fast charging industry?

63 Additional information on this topic is discussed in SEPA's *Utilities & Electric Vehicles: The case for managed charging* report.

Utilities and other industry partners have many opportunities to engage with SEPA on these and other important topics. Now is the time for utilities to proactively evaluate choices for strategic planning around EVs. Strategic plans should include components for infrastructure, customer engagement, and other elements of EV deployment and utility operation assessments, such as an "EV platform" as noted previously. While a utility may not see a high penetration of EVs in its service territory today, it's time to start planning for tomorrow.

We invite utilities and stakeholders to join SEPA's Electric Vehicle Working Group as a starting point to exchange utility project information and participate in working group activities. Additionally, SEPA can provide one-on-one individualized assistance for a utility. For more information, please contact the author at emyers@sepapower.org.

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