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Reducing Soft Costs in Conductive Charging Infrastructure

Chris Nelder[1]

[1](corresponding author) Rocky Mountain Institute, 2940 Junction Place, Boulder, CO 80301, cnelder@rmi.org

Summary

"Soft costs" such as permitting costs, siting costs, utility interconnection application costs, opportunity costs, the cost of delays, and so on create significant overhead for EV charging station network operators. Those costs are ultimately passed on to EV drivers, making it more difficult for EVs to reach cost parity with ICE equivalents. But the soft costs of deploying charging infrastructure are poorly understood, unpredictable, very hard to quantify, and almost entirely undocumented in the literature. Our original research, based on 24 interviews with a variety of stakeholders as well as existing literature and publicly available information on utility procurements, identifies some major categories of soft costs that need to be investigated further. This research should inform future legislation and harmonization of regulations and processes in order to reduce the total system cost of charging infrastructure.

Keywords: charging, infrastructure, conductive charger, DC Fast Charging, deployment

1 Research summary

As utilities and private sector charging networks begin to move beyond the early pilot stage and start building charging infrastructure for electric vehicles (EVs) at scale, it is increasingly important for both utility buyers and utility regulators to understand what charging infrastructure components cost. This is particularly true where utilities own, operate, and recover the cost of EV charging infrastructure through the general rate base, to ensure that ratepayer dollars are invested wisely and in the public interest. Federal, state, and local municipalities, transit agencies, fleet operators, and businesses that want to install workplace chargers also need to understand the wide ranges of these costs and the trade-offs involved in reducing costs.

However, because of wide variability in the cost of nearly every element of charging infrastructure, as well as vendor concerns around protecting proprietary information and competitive advantage, it has been difficult to identify and compare these costs across various vendors and installations.

To address this need, we conducted 24 interviews in the second half of 2019 under nondisclosure agreements with utilities, hardware providers, software providers, operators of charging networks, transit agencies, states, laboratories, contractors and consultancies, as well as existing literature and publicly available information on utility procurements, to identify major categories of soft costs and the ways to reduce them. Our paper [1] summarizes these findings.

We also sought to understand where the best opportunities may be to reduce the total cost of deploying EV charging infrastructure. (Our study does not address Level 1 charging, which requires no additional infrastructure, or operational costs such as utility bills, which we addressed in previous papers. [2]) Those cost-reduction opportunities were clearly greatest in the “soft cost” category.

About 15 years ago, as the solar PV industry was starting to grow at scale, it became clear to industry participants that hardware costs would continue falling along a typical learning curve for a new technology, but that soft costs—such as process costs, marketing costs, permitting costs, opportunity costs, the cost of delays, and so on—would not. These costs created significant overhead for solar providers, increasing their cost of doing business, adding unnecessarily to retail system prices, and slowing down project execution. This prompted the Department of Energy, several U.S. national laboratories, and other parties to begin identifying soft costs and what could be done to reduce them. That research led to the development of federal and state policies designed to reduce costs by streamlining processes, harmonizing codes, and standardizing deployment practices, which ultimately contributed to reducing the total system costs and increasing the rate of deployment for solar PV installations.

A similar effort is now needed for electric vehicle charging infrastructure. Its soft costs are poorly understood, unpredictable, very hard to quantify, and almost entirely undocumented in the literature. Charging network developers cite soft costs as more significant cost drivers than charging station hardware in the U.S., which we suspect is one of the reasons why charger installation costs in the U.S. are three to five times the cost of the chargers themselves—a much higher ratio than that seen in Europe. As with solar PV, there is clearly a need for streamlining processes, harmonizing codes, and standardizing deployment practices in order to accelerate the pace of charging station deployment in the U.S.

If transportation electrification is to proceed at a pace commensurate with meeting the challenge of climate change, we must ensure that recharging an EV at a public charger is no more expensive than refueling a conventional vehicle. Currently, excess costs incurred in deploying charging infrastructure makes that a challenging target. Achieving it will require particular attention to the cost of every element involved in charging infrastructure, and squeezing out costs wherever possible.

We believe our report uncovers some key areas for future study, and that our findings represent important and original insights which are vital for industry participants and a broad array of stakeholders involved in the deployment of charging infrastructure to understand. We hope that our research will inspire a full examination of soft costs in EV charging infrastructure deployment in the U.S., again leveraging the talent, knowledge and tools of multiple national laboratories and the Department of Energy, and building on their experience in researching solar soft costs. We hope that such a full-fledged research effort will lead to policy and process improvements that will reduce wasted time and effort, and thus reduce total system costs and accelerate deployment, just as the research into the soft cots of solar PV did.

2 Identifying and reducing soft costs

We identified three major categories of cost components in deploying EV charging infrastructure.

The first category concerns how components of charging infrastructure are procured. The components include hardware and software, network access contracts and/or cellular data contracts, and maintenance contracts. For this category, we discovered that the cost of EV chargers is following a progression that is very similar to that seen in the solar sector over the past decade: The cost of hardware components that are (or could be) manufactured at scale is already declining along a typical “experience curve” for a new technology, as manufacturers gradually find ways to squeeze cost out of their processes. Software systems are a relatively small part of total infrastructure cost and do not present a significant cost reduction opportunity. There did not appear to be significant opportunity to reduce the costs of network access contracts, cellular data contracts, or maintenance contracts, beyond simply opting not to purchase them. But in many cases, opting not to purchase them is not an option.

The second category concerned requirements mandated by law, specifications, codes, and other regulations. Examples of these requirements include credit card readers on public charging stations (which is required in the state of California); adherence to National Institute of Standards and Technology (NIST) measurement standards; compliance with Americans with Disabilities Act (ADA) requirements; requirements for public DC fast chargers (DCFC) to be equipped with both Combined Charging System (CCS) and CHAdeMO plug types; and compliance with open standards, such as the OCPP, OpenADR, Open Charge Point Interface (OCPI), and Open InterCharge Protocol. Some of these requirements can add to the complexity and cost of an installation, so we surmise that revisiting, standardizing, and harmonizing these rules can reduce the costs of deploying charging stations. However, non-compliance with these requirements is usually not an option either.

What became clear from our expert elicitation is that the greatest opportunity for cost reduction lies in a third category, which we have termed “soft costs”: process costs, marketing costs, opportunity costs, the cost of delays in permitting, and so on (see Fig. 1). These costs are poorly understood, very hard to quantify, and almost entirely undocumented in the literature. We strongly suspect that soft costs are a big part of the reasons why charger installation costs in the United States are three to five times the cost of the charger itself, a much higher ratio than that seen in Europe. Indeed, soft costs were frequently cited as more significant cost drivers than charging station hardware in the United States.

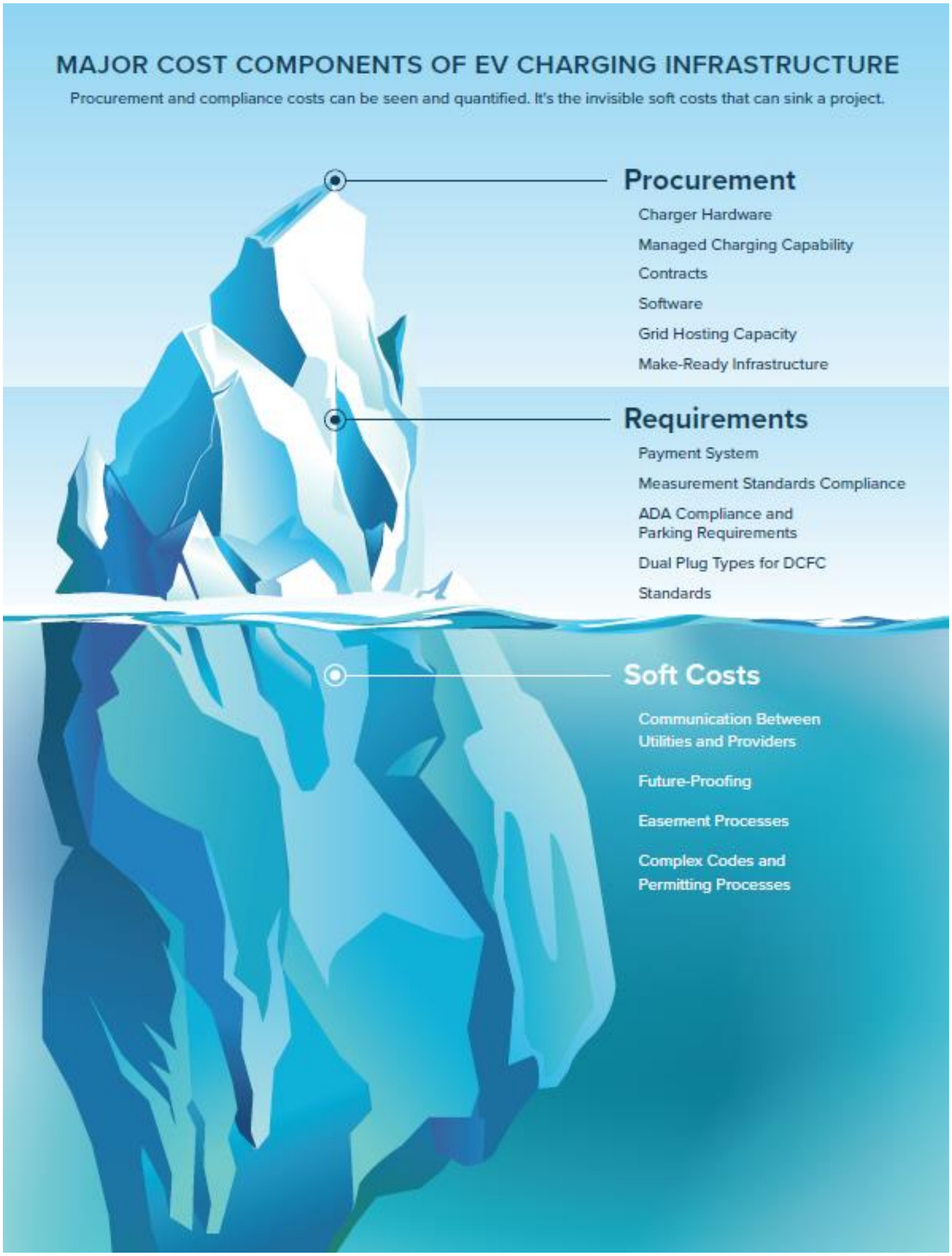

Figure 1: Major Cost Components of EV Charging Infrastructure

In building charging infrastructure, soft costs often consist of delays—for example, delays in obtaining utility interconnections, utility easements, and building permits. Such delays can add weeks, months, or more than a year to a project schedule, with wildly varying cost implications for a project. Worse, because charging network operators (also known as EV service providers, or EVSPs) often have to evaluate multiple potential locations before selecting one, these costs can multiply.

Soft costs can add significantly to a project budget, particularly for public DCFC sites or other large, complex installations, and are borne indirectly by the operators. The experts we interviewed frequently cited soft costs as some of the largest and most unpredictable costs that developers of charging networks encounter, saying they are often the reason why a candidate site for a charging station is rejected or abandoned, even after significant costs have been incurred.

In the remainder of this section, we identify some major kinds of soft costs and how they can be reduced.

2.1 Improve communication between utilities and providers

One issue that charging network operators often cited was poor communication with utilities, which led to costly delays, and forced operators to rework their plans. Most of these issues centered either on understanding the available capacity to add new loads to a distribution network at a prospective site—evaluating multiple prospective sites before the EVSP can select one—or on the process of obtaining a utility interconnection.

When evaluating the grid hosting capacity at a prospective site, EVSPs may encounter wide variance in how much information utilities make available. This is a critical question because high-speed public charging sites can demand a significant amount of power. For example, a bank of six 150 kW DCFC can require nearly a megawatt of power supply—equivalent to that of a high-rise office building. Some utilities have detailed hosting capacity maps at the ready and can give an expedient answer about available capacity at a site, or at least suggest locations that are known to have sufficient available capacity. Other utilities may take weeks to determine how much hosting capacity there is at a site. They may not have hosting capacity maps available, and they may need to send a technician out to the site to evaluate the capacity in person. In some cases, EVSPs may decide to invest in exploring multiple potential sites just to improve the odds that one will be successful, which adds to their total costs of doing business. In the worst cases, EVSPs may find that simply locating a site with sufficient grid capacity can take months.

The process of applying for utility interconnections is also highly variable and unpredictable, and can entail lengthy delays. Although some utilities will alert EVSPs proactively when there will be a delay in interconnection, others will not, exposing EVSPs to the risk of discovering a delay once the project is already under way and potentially putting their investment at risk. If EVSPs were able to get advance notice that a utility interconnection application might be delayed, or were able to estimate the risk of discovering that grid capacity at the site is insufficient and the cost of requisite grid upgrades, it would help them reduce losses and be more efficient in their capital planning, and thus reduce their overall costs. Furthermore, increased communication around the interconnection process can help providers understand and address the nuances of the process in each utility territory. This is particularly true when battery storage is integrated with a DCFC installation, a relatively recent technique for which there is no real standardization and which increases the complexity of an interconnection process.

Some utilities may be willing and able to expand hosting capacity at a given site as part of an existing line extension investment policy, whereas others may require the EVSP to pay for expensive grid upgrades.

Our expert interviewees from EVSPs all said that more support from the host utilities could sharply reduce wasted effort and expense, and thereby help reduce soft costs. They said that the best approach is to have a utility support representative acting as a single point of contact for each charging site project, and that where they have such support, projects proceed more smoothly and with fewer revisions and delays.

The utility representative can help in a variety of ways:

- Ensuring that EVSPs have a single point of contact within the utility for each project. These individuals can help keep EVSPs informed of any potential delays, and more broadly, can track project progress, ensuring adequate communication among all necessary parties.
- Locating requisite information about grid hosting capacity at the proposed site and identifying any needed grid upgrades early on, before significant investment has been made in designing and permitting the site.
- Providing guidance on the process of filing a utility interconnection application, along with all requisite documentation, and then shepherding the applications to completion in an expedited manner to avoid costly project delays.
- Identifying any other EVSP projects that are planned or in-process and that are on the same utility feeder or distribution transformer, or located near the same site, which could be paired or leveraged with the new site to reduce costs. For example, the utility could identify opportunities for multiple projects to share in the cost of a single trenching job and conduit run, or share in the cost of upgrading a transformer that will supply multiple sites.
- Coordinating any needed utility work with the rest of the site preparation, to avoid delays in commissioning the site.
- For utility co-ops, simply making information about grid hosting capacity available to prospective site builders without requiring them to join the co-op first could significantly reduce costs.

Improving utility support to reduce costs could also take the form of better process. For example, a utility could accept a lower cost deposit to help an EVSP evaluate three sites, then help the EVSP select the best candidate. Only after the final site selection is done would the EVSP submit a regular service request and deposit to initiate the full utility interconnection application process.

A more agile process could also help reduce the risk of encountering other showstopper issues that doom or add costs to projects after utility distribution planning work has commenced. These issues are beyond the scope of this work, but they can include any number of hurdles such as discovering that an easement cannot be secured, that amenities at the site are deemed to be inadequate, that 24/7 access cannot be guaranteed, or that landlord/tenant consent cannot be secured. Being able to address these issues before full utility planning work has been completed could reduce costs.

2.2 Future-proof installations

At sites where increased charging needs can be anticipated in the future, utilities and site owners can reduce long-term costs by front-loading investment and installing excess capacity in the make-ready elements when installing the first set of chargers. This helps "future-proof" the site by minimizing the effort and cost required to upgrade the number of chargers or power rating of existing chargers later on, and reducing or eliminating the need to obtain building permits, easements, and utility interconnections when expanding a site. Future-proofing requires balancing the extra cost incurred today against the savings that it can offer in the future. From our interviews, it became clear that existing future-proofing practices can lack clarity, structure, and consistency. Although the degree of future-proofing can be heavily dependent on project budget and who the equipment owner is, there are a few best practices and suggestions that can reduce lifetime costs at a site.

One suggestion is that regulators could allow utilities to rate base extra grid hosting capacity or make-ready capacity at a site if the EVSP can demonstrate that more chargers will be needed to meet demand in the near future. This flexibility would need to be limited and monitored to protect utilities from building make-ready capacity that is never used because an EVSP later decided that it did not need additional stations.

Another money-saving practice that many utilities and EVSPs use is to oversize the transformer and lay additional conduit to support expansion, where the marginal cost of doing so is not prohibitive. Cutting through pavement, opening a trench, and laying conduit and conductors is one of the most expensive parts of an installation, and it is worth the extra effort to avoid doing it twice if possible. In one California project proposal, trenching and conduit contributed around 18% of total project cost. Even if future-proofing mitigates the cost of future trenching and conduit by only 50%, it could still deliver savings on the order of 10% of the total project cost.

Regardless of the methods, sharing current future-proofing practices and informal policies could help customers take advantage of the savings associated with future-proofing.

For example, most of the major charging networks are moving to chargers that can support 150 kW or higher power output levels, and the luxury EV segment is likewise beginning to produce vehicles that can take 150 kW rates of charge. So if one or more EVSPs can anticipate that a given site might, in the future, need to be able to accommodate as many as six vehicles charging at once, it would be wise and cost-effective to build the initial site with 1 MW of grid capacity, conduit, and stub-out infrastructure, even if the site will have only one 50 kW charger for vehicles that can only charge at rates up to 50 kW initially.

However, future-proofing a site by installing more grid and make-ready capacity can also incur unexpected utility costs, such as minimum demand charges or minimum bills, so those issues should be explored with the utility before a decision is made to build excess capacity.

2.3 Simplify obtaining easements

Although easements are not always required, depending on equipment ownership and local policy, variation and complexity in the easement process can cause project delays and additional cost. In one California pilot project report, the utility described a change in easement policy midway through the project (from a blanket easement over the entire property to an easement covering only the charging station infrastructure locations). Because the customers required additional time for legal review, the easement process took longer than anticipated. On average, the process took 59 business days, with some customers taking up to 234 business days, causing construction delays.

2.4 Simplify codes and expedite permitting

Because building codes and permits vary by local jurisdictions, the process of design and approval can be lengthy and complicated. If a single EVSP wanted to install 20 chargers in 10 different jurisdictions, it would have to go through 10 unique permitting processes, and potentially modify its designs 10 different ways to ensure that they complied with local regulations.

Even if all 20 chargers were located within one jurisdiction, its permitting process may be complex enough to force multiple design iterations and create delays in obtaining permits. For example, in California, many zoning reviews require a public hearing, which can introduce a waiting period of several weeks. Typical California building reviews take three to four weeks but can be extended to take six to eight weeks. Nationwide, an average of 1.86 design revisions are required before a design gets approved. In California, that number is even higher, at 2.41 revisions.

To reduce this complexity and streamline the permitting process, the city of Fresno, California, has revisited its permitting process repeatedly, creating progressively more detailed checklists to guide applicants through the permitting process. The city is currently working on a seven-page checklist that will clarify and simplify the requirements to obtain a permit. Other cities would be well-advised to follow suit.

California has also undertaken a statewide effort to streamline the permitting process for EV charging stations in the form of AB 1236 (Statutes of 2015, Chapter 598). [3] It was enacted to speed the permitting process for applicants, give cities and counties better information, and establish best practices for permitting and communication requirements. In response to AB 1236, the state's Governor's Office of Business and Economic Development has created a permitting guidebook providing detailed information on the optimal permitting process and the current restrictions and requirements, as well as a tool to track which local jurisdictions are "permit ready" and have streamlined permitting processes. [4]

Ideally, a similar tool with national coverage could streamline permitting costs across the industry. Even better, if it were possible to establish a single national set of standards governing the permitting process, it could substantially reduce associated complexity and delays nationwide. Even just statewide harmonization around a single set of rules and codes would be a vast improvement over the current balkanized landscape of hundreds of local jurisdictions. If local jurisdictions maintain their unique processes, they should strive to become "permit ready" jurisdictions, per the guidance in the California handbook (or equivalent), where feasible.

2.5 Coordinate and consolidate charging sites

Where it is practical to do so, grouping more chargers at a single site instead of dispersing them across multiple sites can significantly reduce costs in two ways:

- Spreading the fixed costs such as site preparation and utility interconnection across more chargers
- Reducing the number of sites that maintenance personnel must visit

Significant cost savings can also be realized by powering multiple charger ports with as much shared infrastructure as possible:

- At sites owned by a single operator, it may be possible to reduce costs by installing larger switchgear panels and power conversion modules to support more ports. A 200 kW charging station with four ports can be cheaper to buy and install than four self-contained 50 kW charging stations. However, this cost savings can be nullified by higher costs for DC cabling if the dispensers are far from the power cabinets. Also, some EVSPs may elect to install separate charging stations rather than a single station that shares power across multiple dispensers, to ensure a particular rate of charge for each customer.
- At sites where chargers might be owned by more than one charging station operator, the owners should look for opportunities to make shared investments in site hosting capacity analyses, obtaining utility easements, and upgrading the capacity of the electricity grid at the site, such as distribution system feeders, distribution transformers, service drops, trenching, conduit, and conductors. For example, charging infrastructure built for transit vehicles may be shared with other government vehicles, or sites can be codeveloped as public–private partnerships with mixed vehicle uses, and so on.

The value of coordination and consolidation is particularly significant in sites that are located in remote areas far from high-capacity feeders, and in city centers where any sort of construction is complex and expensive. In extreme cases, the cost of power provisioning alone can approach $1 million, so being able to spread that cost across more plugs is a real benefit.

For example, Tesla built 24 chargers and paid for the make-ready for 20 chargers at the same site that Pasadena Power & Light (a municipal utility) owns & operates, saving the utility $140k in make-ready costs. [5]

2.6 Install charging infrastructure during construction

The cheapest way to install charging infrastructure is to build it as part of a new building or parking facility, or during a major facility upgrade. Installing charging infrastructure as part of a construction project can eliminate much of the iterative design costs and soft costs, as well as reduce costly retrofit trenching through existing concrete or asphalt parking lots. Some states and communities already require charging infrastructure to be installed with new buildings and parking facilities, or as part of major facility upgrades.

2.7 Communicate and standardize ADA compliance requirements

Another way that municipal building departments can help reduce charging infrastructure costs is by clearly communicating the requirements for ADA compliance before the site owner begins engineering work. Horror stories abound about unnecessary costs related to ADA compliance:

- Sites that were originally deemed to be ADA compliant, then were repowered with larger chargers, and forced to demolish the original pads and bollards and rebuild them because the upgraded chargers made the sites noncompliant
- Sites where the given ADA requirements were incomplete, vague, or incorrect, and site owners were forced to re-engineer and rebuild to meet different requirements in order to obtain a final sign-off on the project
- Sites where it was not practical to meet the given ADA requirements because charging station equipment was not available that could conform to them, or because the physical site was not oriented in a way that made compliance possible

Furthermore, the California requirement that a site with up to four charging stations only needs one ADA-compliant space, but a site with five to twenty-five charging stations needs two compliant spaces (one of which must be reserved for handicapped users), is in direct conflict with potential savings associated with larger charging sites. We heard that because of this regulation, EVSPs would cap sites at four chargers. (And, as noted previously, California's 2019 law, AB 1100, is aimed at helping to alleviate the impact of this requirement. [6])

Although we are not advocating for fewer ADA-compliant spots, it is important to note the ways in which ADA compliance can contribute to higher costs. Essentially, this ADA compliance requirement is working against the cost savings opportunity of building more charging stations per site, to spread the site's significant fixed costs across a larger number of ports.

Ultimately, the balkanized landscape of state ADA requirements probably needs to be replaced with a common federal standard that EVSPs can build to, reliably, nationwide. But in the absence of such a common standard, state and municipal officials can help reduce costs by simply offering clearer information and better guidance to EVSPs.

3 Recommendations for further study

According to the US Department of Energy Solar Energy Technologies Office, the soft or "plug-in" costs of solar account for as much as 64% of the total cost of a new solar system. Although we were not able to obtain sufficient data within the scope of our study to make a precise determination of the magnitude of the soft costs of EV charging infrastructure, we believe the evidence we have gathered for this study suggests that they could have a similar share of total project costs as they do for solar projects. And we believe our study makes a compelling case for why much more extensive exploration of soft costs in EV charging infrastructure in the United States is needed—an exploration well beyond the scope of our study.

Just as it took the combined and sustained efforts over several years of the US Department of Energy, multiple US national laboratories, and nongovernmental organizations to discover and present comprehensive findings on soft costs and how they can be reduced for solar projects, we believe it will take a similar level of effort to really understand the soft costs of EV charging infrastructure and how they can be reduced. We strongly advise that such an effort be undertaken with all due haste.

Once that information is gathered, the efforts of a wide variety of actors, including regulatory agencies, civic officials, the staff of local building and planning departments, utilities, and private sector charging network operators will be needed to implement their recommendations. This will likely require the vigorous support of legislators and regulators.

More broadly, the total cost of operating public charging infrastructure needs further study. As we detailed in our previous reports, inappropriate utility tariffs can make the business case for owning public chargers challenging and inhibit their deployment. Even small incremental costs, like a $20/month networking fee for a nonresidential Level 2 charger, can eliminate the cost advantage of owning an EV over a conventional petroleum-powered vehicle when those costs are passed along to drivers. This is particularly relevant to drivers who must use public chargers because they don't have a place at home to charge up overnight. If transportation electrification is to proceed at a pace commensurate with meeting the challenge of climate change, we must ensure that recharging an EV at a public charger is no more expensive than refueling a conventional vehicle. Getting there will require particular attention to the cost of every element involved in charging infrastructure and squeezing out costs wherever possible.

4 Acknowledgments

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6 Authors

Chris Nelder is a Manager in the Mobility practice at the Rocky Mountain Institute in Boulder, Colorado, where he heads the EV-Grid Integration team. Chris is a co-author of the recently published journal article "Interrogating uncertainty in energy forecasts: the case of the shale gas boom" (Reed, A., Ericson, S., Bazilian, M. et al. Energy Transit (2019). https://doi.org/10.1007/s41825-019-00015-9) Chris has written about energy and investing for more than a decade. He is the author two books on energy and investing, as well as more than 200 articles on energy in publications such as *Nature*, *Scientific American*, *Slate*, *The Atlantic*, *Quartz*, *Financial Times*, *Greentech Media*, *SmartPlanet*, and the *Economist Intelligence Unit*. He is also the host of the Energy Transition Show podcast (www.energytransitionshow.com).