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# The future of public DCFC infrastructure

Michael Lumbley

Rove Charging

*Co-Founder & VP of Corporate Development, 2060 Placentia Ave, Suite C3, Costa Mesa, CA 92627, michael@rovecharging.com*

**Executive Summary**

The future of public charging must not let what has been done stand in the way of what can be done. We need to provide a dramatically improved end user experience if EVs are to win over Internal Combustion Engine (ICE) drivers. With the very utilitarian experience that has emerged from the compliance version of public charging, there is much room for improvement. However, for public fast charging to succeed, it will need to give the end users what they want while addressing the numerous challenges that the electrical demand of DCFC (Direct Current Fast Charging) creates for the Charge Point Operator (CPO). This balance of end user experience and energy infrastructure is possible, but can it be profitable as well? The answer is yes, but only if the industry and public sector stakeholders come together to build a better solution based on higher expectations.

## 1 The problem

Currently if you were to ask any EV driver outside of the Tesla environment what the #1 problem with EV ownership is they would say charging (Fig.1). With non-Tesla drivers only 61% satisfied with their charging experience and even Tesla drivers only 74%. The problem is layered though, as it can be difficult to conveniently access charging, and when you do find a charge point, will the chargers work, or will there be invisible connectivity issues that prevent you from being able to charge? Or the infamous Interoperability issue of having to download a new app, enter your payment information again with no guarantee that once you're done, you will be able to charge then. If we are to convince the folks that drive Chevy trucks to leave that vehicle behind, we will need DCFC to function as seamlessly as current fueling infrastructure.

- **Public charger operability and maintenance a key issue:** Growth of the public charging infrastructure is making it easier for EV owners to find public charging stations. The index for ease of finding a location is 724 among users of DC fast chargers and 683 among users of Level 2 chargers. But the industry needs to do a better job of maintaining existing charging stations. The study finds that one out of every five respondents ended up not charging their vehicle during their visit. Of those who didn't charge, 72% indicated that it was due to the station malfunctioning or being out of service.

[1] J.D. Power and Associates – 2022 US Electric Vehicle Experience EVX Public Charging Study

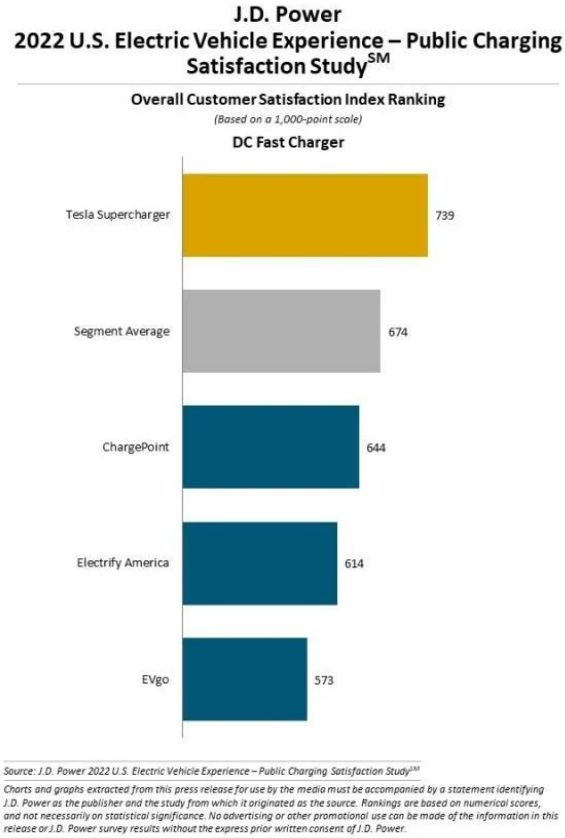


Fig.1

## 1.1 The early days

In the beginning, courts ordered utility service providers and energy companies to deploy charging infrastructure as a compliance measure in the case of NRG starting EVgo, or a punitive measure due to court ordered settlements like the Electrify America/VW/diesel scandal, which makes it easy to understand how the "*deploy it in the back of a parking lot"* model was conceived. When a company is deploying infrastructure at the direction of the courts, they are not concerned about convenience and reliability more concerned with capital deployment than customer convenience and satisfaction. As a result, it is not surprising that this approach has several shortcomings, not the least of which is the lack of any of the familiar conveniences that ICE drivers consider minimum requirements for their fueling experience.

Early adopters were willing to indulge the inconvenience since their inspiration for going electric was based on concern for the environment and a sense that they were doing something important for posterity. However, as we reach this tipping point where mass adoption is right around the corner, the mass market is less forgiving.

Another aspect that was easily overlooked from this early perspective was the practical application and ongoing operation of the hardware. No vehicles were capable of DC fast charging, so there was no need for robust interconnections or energy management. The proliferation of "dumb" level 1 and level 2 hardware had no visibility after it was deployed and as a result, systems were tied in where they could be, and left to function on their own, or not. All of this manifested itself into the charging experience of consistent disappointment and very low expectations.

## 1.2 The status quo

Currently charging is still mired with many of these original model issues, but now mass market has turned and "how it has always been done" will not suffice as the market matures. To that end, as drivers migrate from ICE vehicles, charging must evolve to offer similar comfort and convenience, which requires an immensely different approach. This is true for every aspect of the ecosystem.

# 2 Full-Service Charging

The need for fast charging that meets the expectations of drivers, and the demand of the market requires deployment of advanced power electronics, which comes with considerable up-front investment. Beyond that, having access to the type of amenities that ICE drivers are accustomed to also requires major upfront investment. This means CPOs will need to work together with the public sector stakeholders to increase reliability, mitigate grid impacts, while building a robust, consistent, and convenient experience that allows drivers to feel comfortable making the transition to EVs. This is no small task, but big opportunities rarely come without real challenges.

## 2.1 Amenities and Personnel

Providing facilities where people can get out of their vehicles, grab a bite to eat and have access to a restroom is what people expect. At a minimum, drivers expect to be able to exit their vehicles in a safe environment and have charging work when they plug in. However, as you consider operating a site with amenities, it also affords the opportunity to have personnel onsite to assist drivers when technical challenges arise. Though this is rarely the case today, bringing personnel on site to provide base level support and operate the locations needs to be part of the equation for publicly accessible DCFC infrastructure. Without it, simple issues can take hardware offline and leave drivers wating unnecessarily for access to limited functional infrastructure. This would be unacceptable in the context of traditional fueling infrastructure, and if we are going to achieve the goal of electrifying transport, then the deployment of DC fast charging is going to have to meet, if not exceed, the minimum expectations for liquid fueling infrastructure.

## 2.2 Energy Infrastructure

The underlying problem is due to the fact that utilities don't build infrastructure or integrate capacity to go unused on their networks. Finding sufficient power is a challenge for a DCFC operation. A site may use as much electricity as a mall complex or small neighborhood. Bringing the necessary hardware to mitigate the impact of DCFC on the grid, CPOs can not only control their operating costs, but they can also play a critical role in ensuring that the transition to electrified transport does not create more problems than it solves. Battery energy storage, advanced energy management and renewable energy supply are critical to achieving the potential of electrified transport. Navigating the installation of that hardware is no small task.

Intelligent siting ensures easy access for drivers, while also allowing the ability to interconnect the type of electrical demand a DCFC station creates. Though this is possible, it is not commonplace. The market need is necessitating changes in the way developers site infrastructure, how utility services providers structure rate tariffs and how cities and AHJs process entitlements and permitting applications. This means that private sector stakeholders are going to have to improve their efforts on transparency, education and accountability, and the public sector stakeholders are going to have to improve their process efficiency and accessibility.

# 3 The solution has a problem

To meet the growing demand, the speed of implementation must improve dramatically to allow for the deployment of the needed infrastructure at scale. This means utilities, grid operators, municipalities, and all the other Authorities Having Jurisdiction (AHJs), need to be introduced to, familiarized with the components, and work with CPOs to expedite deployment. It is our hope that we can illuminate the advantages of succeeding at this together, so that all parties can cooperate to accomplish the task at hand. In the end, what the market needs is charging infrastructure that works in a timeframe that doesn't undermine the perception of the transition.

### 3.1 A comprehensive roadmap for scaling through standardization, cooperative implementation, reporting and compliance

To successfully deploy the amount of DC fast charging needed to support a 100% electrified fleet in California, both private sector and public sector stakeholders will need to cooperate to create an efficient and

effective process for development, deployment, and operation. This means addressing shortcomings on both sides of the fence, creating common and agreed expectations around processes, and working together to implement those new procedures and guidelines.

### 3.1.1 What is needed from the Private Sector

For everything the private sector has gotten right in its efforts so far, there are some glaring issues that create consistent problems in the field. Among these are endemic hardware failures, a confusing landscape of apps, and a lack of transparency into the points of failure. These issues have eroded trust in the availability and accessibility of functional charging and have become the weaknesses that opponents of a transition to electrification point to as proof that it can't work. Solving these issues requires a proactive approach on the part of all stakeholders. This is not a time to obfuscate the issues by pointing to site uptime (instead of charger uptime) or cherry picking data to align with desired quarterly disclosures. We must identify and resolve the issues systematically and transparently to regain the trust of the drivers that have converted and build the reputation for providing the superior experience, just as we have for providing the better technology

These are issues that are impeding the industry as a whole and in order to assume the mantle of the better solution, we need to work together to resolve them quickly and effectively.

#### 3.1.1.a Root cause analysis for Charging Session Failures (CSF)

We need to see standardized reporting of the exact error codes and/or last operational step data from EVSPs for every CSF.

**Was it:**

1) Lack of connectivity, signal, or bandwidth issues
2) Operating system failure due to an Operating System (OS) update failing to install, payment process failure loop, or other internal process stuck needing a system reboot
3) Hardware issue, component failure or maintenance required event
4) Insufficient power, tripped breaker, broken line, or power outage

Specifically, we need to systematically identify the exact point of failure (whether software, technical or physical hardware), focus on resolving the most frequent problems, and start standardizing fixes across the industry. This would also level the playing field for reporting uptime for CPOs. No more shrugging or using site uptime to obfuscate endemic issues, or cherry picking systems to report on to improve public facing statistics.

#### 3.1.1.b Interoperability and ISO 15118 standardization across OEMs

The vehicle OEMs will need a standardized and well understood protocol so that *all vehicles* operate with the same handshake protocols that connects the vehicle and the charger to communicate the charge the vehicle needs to receive and that every vehicle can connect to every charger with a universally accepted set of credentials. This will allow a charging session transaction to occur with no need for a driver to enter information locally at the charger, or in an app. Just like ICE fueling stations, a payment terminal on the EVSE would always need to be available as a redundant failsafe.

Efforts to develop ISO 15118, the standard for ubiquitous "Plug and Charge" are already underway through our industry associations Hubject ™ and universal testing systems like Charin™ and their CCTS tool for testing interoperability are steps in the right direction. However, there are always compromises that must be made when developing these types of standards since they are invariably seen as stifling innovation by groups who believe they are developing a new and unique solution. Proprietary solutions from numerous OEMs on both the EVSE and vehicle manufacturer sides has led to a fractured market experience and unnecessary uncertainty.

### 3.1.1.c Standardization of charge port proximity (OEMs) and cable length (EVSEs)

As evidenced in the recent opening of the Tesla networks to other OEM's vehicles, the lack of standardization can leave drivers with no other option than to take up two spaces (because the cable won't reach the port side on a Rivian - driver's side front) or with a Ford Lightning F-150 where you must pull up sideways. This would never happen with ICE vehicles, and if we are to reach true mass adoption, we will need to function as seamlessly as current fueling infrastructure. Whether this entails a standardization of cable length for EVSE capable of serving the approximate port location of the majority of vehicles or creating an agreed standard for the location of the port on the vehicles, a functional standard that does not significantly increase cost is not far from realization. The industry needs to come together to identify, define and implement a standard that prevents awkward and unnecessary confusion on the part of drivers when they reach a charger

### 3.1.2 What is needed from the Public Sector

Of course, the public sector role in facilitating the successful transition to electrification is multifaceted and profound. With everything from code, permitting, generation, transmission and regulatory, there are numerous places where aligning on best practices will both reduce friction internal in internal processes, it can also provide a model of cooperation with the industry as it scales to facilitate a fully electrified fleet.

This is a precarious inflection point, but also an incredible opportunity to build a system of cooperation for the future that will serve as the underlying architecture for a bold new era for our economy and population. Electricity is the fuel of the future, and it is our shared responsibility to ensure the implementation is delivered in with the least resistance, the greatest equity and maximum benefit

#### 3.1.2.a Standardized submission packages and guidelines:

Cities and utilities should work with developers to create a streamlined and simplified submission processes that is clear, replicable, and scalable.

This could include:

1. reducing the number of required permits or limiting turnaround time
2. providing pre-approved hardware lists and approved configurations
3. establishing uniform online submission packets with
4. creating a dedicated internal EV team / point of contact / landing page
5. expanding online visibility to existing infrastructure, capacity maps and grid metrics

**1. Reduce / Update Regulations:** Cities and utilities should update existing regulations to ensure that they are up-to-date and do not hinder the development of charging infrastructure. This could include reducing the number of required permits, providing fixed/expedited review timelines, and expanding existing infrastructure to support the review and approval for installation of DCFC charging. This could include using digital signatures, electronic forms, and electronic document sharing to allow for submission, review, and approval of applications quickly and easily.

**2. Pre-Approved Hardware and Design Criteria:** Cities and utilities could create a readily accessible list of known vendors that have already made it through the permitting process and are pre-approved for deployment in that particular jurisdiction, like the California Energy Commission (CEC) approved hardware list. Also, if there could be a list of configurations of hardware and software, like a combination of a particular EVSE and EVSP, or battery and Energy Management System/Battery Management System (EMS/BMS), that has already been reviewed and approved for deployment within that jurisdiction. These would help developers understand that if they are bringing novel or innovative system designs, they can expect a longer process and might opt for a previously approved and clearly understood design for deployment.

**3. Establish Uniform Online Submission Packets for Permitting:** Cities and utilities should create a fast-track permitting process that would employ standard digital forms and structured submission process like a checklist where partners upload site docs, design docs, equipment package, etc., so that the process was essentially following the required checklist every time. This would allow developers to use templatized documents, in a consistent, structured online application process to get approved quickly and begin construction, which would speed up the installation of charging infrastructure.

**4. Create a Single Point of Contact:** Cities and utilities should create a single department and/or point of contact for developers who are looking to install DCFC infrastructure. This would make it easier for developers to get their projects approved, and it would also give the city or utility a better understanding of the developers' goals and needs. Also having a dedicated website or landing page for development partners to find forms, processes and points of contact would dramatically reduce the peripheral requests going to departments who are not familiar with the equipment, processes and talking points.

**5. Expand/Open Visibility on Service and Capacity Map:** Cities and utilities should use technology to facilitate the development process by affording developers access to updated and accurate capacity maps to better identify where existing capacity supports deployment of the high demand equipment associated with DCFC. Currently the maps that purport to display real time grid availability are frequently

### 3.1.3 DERs, Rate Structures and Tariff Design

One of the most challenging aspects to address is creating rate structures and tariffs that don't inhibit, or worse, prevent market deployment due to unintentionally punishing market participants. In the shift to electrification, utility service providers are set to inherit the $562B+ in annual revenue [(2)] that was spent in the US on fueling in 2022. This influx will be a major windfall and allows for creative thinking around items like Facility Fees and Demand Charges.

Though there are certainly grid operating costs and infrastructure implications that will be inherent in transitioning the transportation sector to electricity instead of liquid fuels, the levers that were used to influence demand and ensure profitability need to be re-evaluated to not impede implementation. The new grid will have functionalities and reciprocal benefits that grid operators from the days of Demand Charge rate design would never have imagined. That is without even pointing to the underlying methodology of demand charges as a form of grid maintenance cost recovery being flawed inherently [(3)]. Research has repeatedly shown that TOU (Time of Use) rates are far more meaningful when trying to impact consumer behavior and commercial development [(4)]. To that end, incentivizing investment in electrical infrastructure, like batteries and Energy Management Systems, in conjunction with TOU rates would be vastly more effective at hedging demand during critical peaks while not creating cost prohibitive scenarios that will prevent investment in DCFC. Also, the distributed assets could play an extremely important role in the grid of the future, either serving as support DERs for the utility service providers or allowing CPOs to serve as VPPs (Virtual Power Plants) by virtue of design and incentive structuring.

The optimal solution would be a fully inclusive rate design effort that incorporated feedback from USPs, ISOs, RTOs, and CPOs to ensure that proper cost allocations were being addressed while not becoming prohibitively burdensome. There is a fine line to be struck where the considerable demand and wear that will incurred by the transmission and distribution systems are addressed while also allowing for acceptable return for DCFC infrastructure developers. Much like Telecom had its revolution in the 90's and early 00's, the grid is evolving into the fully integrated transactional backbone of our economy. We must plan, support, protect and intelligently design this next chapter.

## 4. Closing Statement

In the end, it is our sincere hope that through a cooperative and collaborative effort, we can meet the exploding demand for a better DC fast charging experience that addresses both the complex needs of the market while being good partners with our grid operating colleagues. We have the tools and are dedicated to the outcome. Now is the time to come together to build the next phase of electrified transportation in the US. We can do this. It just requires not letting what has been done stand in the way of what can be done.

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## Presenter Biography

Mr Lumbley is Co-Founder of Rove Charging and a career energy development professional with more than 20 years' experience in solar, energy storage and EV infrastructure . After starting his energy career in the oil and gas sector, he transitioned to focus exclusively on clean energy projects in the early 2000s. Since then, he has worked for SolarCity and RGS, 2 of the top 3 utility scale solar development firms in the US before shifting his focus to the EV charging infrastructure sector. As a result, he and his team bring a unique perspective to the energy aspect of EV infrastructure, while also focusing on dramatically improving the end user experience. The result is delivering an energy intelligent solution that mitigates grid impacts while dramatically improving the public charging experience for EV drivers.

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