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# Ample Inc. Comments on Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment

*Additional submitted attachment is included below.*

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## *Ample Inc. Comments on Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment*

AMPLE, Inc. appreciates the opportunity to provide comments to the California Energy Commission (CEC) regarding Implementation of AB 2127 Electric Vehicle Charging Infrastructure Assessments (Docket # 19-AB-2127).

The assessment indicates a number of prerequisites and challenges for large scale rollout of infrastructure in California to support the state's transition to a 100% electric light duty vehicle (LDV) parc. Key areas of focus include: meeting EV charging infrastructure demand; the economic viability of public EV charging infrastructure; utilization of DC Fast Charge (DCFC) infrastructure by transportation network companies and fleets; accessibility of EV charging infrastructure in population-dense areas; integration of DC fast chargers with expanding renewable energy generation; and requirements for supporting road trips through EV charging infrastructure. We submit that under the current EV infrastructure paradigm, reconciling the needs of speed, affordability and cost is not possible. That is because today's EV system rests on two pillars: slow charging (either L1 or L2) at home or work, and DC fast charging in public locations. Unfortunately, neither of these can replace the convenience and affordability of gasoline or diesel in a wide range of applications.

As noted in Chapter 7 of the Electric Vehicle Charging Assessment, public EV charging is not currently economically viable and relies on public subsidies. In light of this, we urge the California Energy Commission to consider the benefits of battery swap and in particular, Ample's modular battery swap as a solution for EV drivers who are unable to charge at home, require fast refueling or need to travel long

distances. Battery swap is also an ideal solution for electrifying fleets as it costs substantially less than installing other kinds of charging infrastructure and also facilitates higher utilization factors for fleet vehicles.

Modular battery swap can help California achieve stated goals for EV deployment (8 million EVs by 2030) and allow the world to decarbonize mobility in line with the Paris Agreement and a 1.5 degree Celsius global warming target.

**What is Ample and what is modular battery swap?**
Ample, is a San Francisco-based company that has pioneered modular battery swap and solved the challenge of how to deliver energy to electric vehicles in under 10-minutes without straining the grid, while accounting for renewable energy intermittency and reducing the cumulative need for massive carbon-intensive EV batteries. Ample's modular battery swap system is economically self-sustaining, flexible and has already been integrated into nine distinct vehicle models from five different OEMs. Not only is Ample's refueling fast and affordable, installation of swap stations is too.

**How can Ample accelerate deployment of EV charging infrastructure?**
In order to limit climate change to no more than 1.5C, emergency measures must be taken to reduce carbon emissions. In America, transportation is the largest contributor to energy-related GHG emissions, and globally emissions must fall by roughly 50% within a decade. Over the same period demand for mobility will grow by ~70% thanks to economic expansion in countries like China, India and regions like sub-saharan Africa. The world needs technologies and business models that serve customers far beyond suburban America's two-car garages. Electrification must reach into cities with high-rise apartment buildings and densely packed street parking, rural communities, corridors for interstate travel and commerce, and mobility fleets – which will account for a disproportionate share of vehicle miles traveled. Ample's solution fills this gap.

This is because Ample outcompetes DC fast charging and gasoline on key metrics (see graphic 1). Refueling by battery swap takes roughly the same amount of time as stopping at a gas station and energy cost is competitive with the most affordable modes of fast charging. Compared to DC fast charge, Ample is also very efficient. Fast chargers lose a significant amount of energy during the process of transferring energy into an EV battery. This lost energy manifests as heat (both in the charging cable and the battery itself), which degrades and reduces the lifespan of EV batteries. By slow-charging batteries, Ample minimizes energy loss, reduces temperature and effectively extends battery life span.

Speed of deployment is also a key differentiator. Most EV charging stations take many months if not years to site and build. Because Ample is designed to be assembled on site and requires no construction (trenching, pouring concrete pads, etc.), Ample stations can deploy in days. Perhaps most importantly, Ample can store renewable energy when it is available and deliver that clean energy to an EV quickly and when it is needed. This energy storage capacity fills a huge gap in our energy supply system. Deploying an Ample pod costs less than deploying a DC fast charger, but fast swap times mean that Ample achieves much higher capacity factors – offsetting demand charges and reducing the need for costly grid upgrades. On average, DC fast chargers operate only 5% of the time. Ample can charge batteries up to 100% of the time because batteries can charge while the vehicle is in use. This means that Ample can deliver a roughly 10X improvement over today's fast chargers (2.5 vehicles/day on average for a DC fast charger vs. 25+ vehicles/day for Ample). Ample enables a step change in California's ability to meet EV charging needs by means of public charging and reduces the cost of installing infrastructure for EVs (see Figure 1).

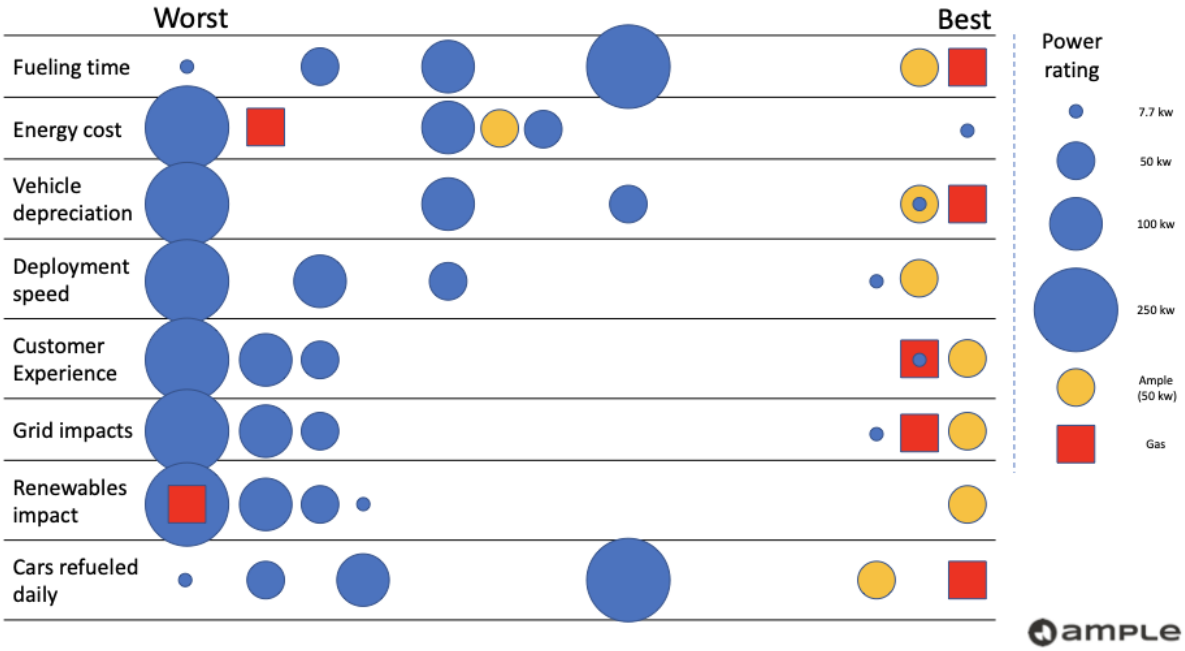


*Figure 1: Ample, Charging and Gasoline: How they stack up*

Because of the speed and efficiency with which Ample can swap batteries, the system is the equivalent of an electric gas station and is economically profitable.

**Why not rely on home charging?**
In its base case scenario, CEC's EV PRO-1 modeling assumes an extremely high rate of home charging availability for electric vehicles (92%). These numbers are unrealistic. According to research from Carnegie Mellon University only 22% of Americans have access to a dedicated parking spot with overnight charging available (this includes both standard 110 volt outlets and 240 volt level 2 charging). The International Council on Clean Transportation (ICCT) estimates fewer than half of Americans have access to a dedicated parking spot with overnight charging available. Extending overnight charging to the rest of Americans is prohibitively expensive and logistically unrealistic.

**Why not rely on DC fast charging?**
On the other hand, DC fast chargers are expensive to install (between $50k and $210k per plug) and operate. Because of this, DC fast charge networks will require prolonged government subsidies. An example of why can be found in Norway in 2017 -- which represented the peak ratio of EVs to DC fast chargers in Europe. In 2017, the average fast charger in Norway only dispensed 9kwh of electricity per day -- significantly less than one Nissan Leaf battery. A survey of 40 DC fast chargers by Florida Power and Light (Florida is America's 4th largest EV market) showed half of their DC fast chargers with utilization under 6% and none higher than 22%.

Because of the logistics and economics of fast charging as well as the heavy toll they place on the grid, they are not an adequate solution for MUDs, fleets,  or TNCs. With EVs approaching cost parity to ICE vehicles, our charging solutions must serve communities beyond privileged early adopters and suburbs.

**How should CEC update its EV infrastructure planning in light of the reemergence of battery swap?**

CEC's Electric Vehicle Charging Infrastructure Assessment omits the key variable of battery swap. In China (which has over 80% of the world's public DC Fast Chargers) a major shift towards battery swap is already underway. The EV manufacturer NIO swaps batteries millions of times annually and every other major Chinese EV company has deployed a battery swap solution (many targeted towards fleets and taxis). Even with CEC's optimistic assumptions regarding levels of home charging infrastructure (92%), it still assumes a ratio of public fast chargers to EVs of roughly 5:1 in 2030. In contrast, battery swap requires no home charging and today each 50kw Ample station can support roughly 150 vehicles (this scales with power input), requires only two parking spots, and can be deployed in days. In other words, Ample can service the same fleet, with an order of magnitude fewer chargers.

**The path forward**

Just as EVs represent a paradigm shift away from internal combustion engines, there must be a paradigm shift on EV charging. EV charging will be part of the solution for refueling electric cars. However, the economics and speed at which vehicles charge and infrastructure can be deployed means that battery swapping must increasingly be viewed as a primary mode of public EV refueling. This shift is already under way in more developed EV markets like China.

Ample is currently managing a deployment with a global TNC in the San Francisco Bay Area. The company will expand its offerings to other large fleets, TNCs, MUD-dwellers and rural communities soon. Ample's system allows electric vehicles to refuel in minutes and pay for energy on a per-mile basis -- just like gasoline. The system also bridges the gap between sustainability and convenience by absorbing renewable energy when it is available, storing it and refueling electric vehicles within minutes.

Today's pace of electrification is not nearly fast enough to achieve critically important climate goals and the economics do not pencil out absent massive and sustained government subsidies. The zero-carbon EV revolution cannot be supported by slow and fast charging alone. As Ample deploys its modular battery swapping system at scale in 2021, we urge the California Energy Commission to find ways to support this effort and integrate swap into future planning and funding efforts. California needs to support a new generation of battery swap, because the critical work of decarbonizing mobility needs to go faster.