Silicon carbide solutions meet fast-charging infrastructure design requirements

Interest in electric vehicles (EVs) is up globally, but a key tipping point for turning that interest into a purchase is having a fast EV-charging infrastructure that can reduce range anxiety.

Around the world, there’s a realization that if car owners are to confidently make the switch to an EV, there needs to be the ability for them to easily and quickly charge their vehicles anywhere in the country. They want to embark on the same long-haul road trips that a traditional combustible engine is capable of. The demand for this infrastructure is more pressing than ever as manufacturers work hard to meet people’s expectations for sleek, quiet, and environmentally friendly EVs, while government policies worldwide also offer numerous incentives.

But even in EV-friendly areas, there remain challenges for building out a charging infrastructure. Aside from driver expectations, it must also anticipate evolving needs as well as consider the impact on power grids.

Cree | Wolfspeed sees silicon carbide (SiC)-based solutions as the best option for meeting the design needs of all stakeholders and fulfilling the rapid, global demand for fast EV-charging infrastructure.

Automakers and environmental policy accelerate fast EV-charging infrastructure demand

The need for a fast-charging infrastructure is worldwide, as all the major automakers ramp up EV production and governments at many levels create a regulatory environment that encourages adoption.

Global OEMs, including Tesla, Porsche, Daimler, Ford, BMW, and many others have announced more than $300 billion of EV investments. Through marketing and advertising, they are painting a picture of the future in which EVs are the prominent mode of transportation.

Meanwhile, many governments worldwide, including the U.S., Canada, China, and many European countries, have implemented policy favoring environmentally friendly transportation that requires the support of a fast EV-charging infrastructure. For example, the European Union’s CO₂ standards will dramatically alter the European car market in the coming years, with just over a third of all vehicles expected to be hybrid/electric by 2025.

As the desire for cleaner air drives the demand for EVs, interested car buyers must have assurance that they can quickly power up their EVs as easily as they can find gas — even on a long road trip.
And when it comes to range anxiety, look no further than Canada, which has huge gaps between major centers. National retailer Canadian Tire recently expanded its fast-charging station count in central and western parts of the country thanks in part to federal government support, while Electrify Canada, a sister company of Electrify America, launched its nationwide EV-charging network in October 2019 with more than 20 installations at Canadian Tire locations.

Like Canada, the U.S. has significant gaps between major travel destinations that require a fast EV-charging infrastructure. To help address range anxiety, Electrify America and Bank of America (BOA) recently announced a partnership to bring approximately 40 EV charging station locations with a total of 140 EV chargers to BOA locations across eight states.

Meanwhile, distances between cities and towns in European countries may be a lot shorter, relatively speaking, but there’s a push to build out infrastructure to support EVs. The city of Rüsselsheim am Main in Germany is transforming into an “electric city” in part through the installation of 1,300 charging points, making it the highest density in the European Union, with one per 72 residents. Spain, France, and the U.K. are also seeing an uptick in investment in technology and deployment of charging infrastructure as well.

Finally, China arguably can be considered the leader in pushing the demand for a fast EV-charging infrastructure both by supporting companies and incentivizing consumers. In 2019, for example, a state-owned fund invested $1.4 billion into Chinese automaker NIO, while EV manufacturer BYD has transformed the city of Shenzhen into one that relies only on electric buses. In many ways, China’s efforts to put more EVs on the road to reduce greenhouse gas emissions and be a leader in the market is compelling the rest of the world to go greener, further accelerating the need for better charging capabilities.

Longer term, any and all infrastructure will have to be fast-charging, and for all the progress that’s being made worldwide, there are many challenges that must be overcome if a truly fast EV-charging infrastructure is to be built out between cities and across countries without any gaps.

**Fast-charging designs must satisfy multiple stakeholders and technical requirements**

It’s one thing to build out fast EV-charging infrastructure in unused locations, whether it’s the heart of a city or along a highway as part of a chain of traditional gas stations, but if you’re going to mirror the convenience and dependability of traditional gas-fueled vehicles, there are many requirements for the fast EV-charging stations themselves, as well as the needs and expectations of several key stakeholders to consider.
It’s not just EV owners who are affected. For example, it’s also businesses that may want to build out an EV-powered fleet, condo towers that want to house fast chargers, and municipalities that must weigh the impact of charging infrastructure on the power grid. Most utilities are a mix of aging equipment that goes back decades and newer systems that were added as cities grew outward. Looking ahead, it is obvious that all types of utilities will be put under tremendous pressure to be highly efficient in order to meet the increased demands of a new, fast EV-charging infrastructure.

Drivers, meanwhile, are going to expect the same charging experience everywhere they go, so fast EV-charging infrastructure is going to have to be integrated into centuries-old historic neighborhoods as cleanly as they are at service stations on an interstate or in a brand-new condo tower. Businesses with EV-powered fleets also are going to have high standards so they can be confident that their vehicles can keep running and meet their own customer expectations.

The requirements for fast chargers themselves are numerous and vary from customer to customer, although their expectations do overlap. Both municipalities and businesses alike are expecting designs that are rugged, connected, and flexible — universal, ideally — that are robust enough for dirty and wet environments, and ready for any weather conditions from around the world. Businesses also require that chargers be small, high-efficiency, and affordable, as do car owners, whose key design requirements are something that’s light, reliable, and easily installed.

Finally, range anxiety is not the only long-haul concern. Any fast EV-charging infrastructure must anticipate future requirements and customer experience expectations, including bidirectional capability and e-commerce capabilities. No stakeholder in the fast EV-charging ecosystem wants to put time, effort, and money into infrastructure that will have to be replaced in a few years’ time. A fast charger solution based upon new, highly efficient SiC power devices ticks all the boxes from a design perspective while supporting the longevity and flexibility inherent in a resilient infrastructure that must satisfy a wide variety of customers and needs.

**SiC-based solutions satisfy tomorrow’s charging demands**

The global demand for fast EV-charging infrastructure means we need high power and faster chargers, and they must be abundant and cost-effective. Ultimately, this must be reflected within the hardware, and SiC MOSFETs and diodes must meet all the overlapping design goals of car owners, businesses, and municipalities.

SiC is an alternative base material to today’s silicon semiconductors. SiC material properties enable smaller, faster switching, more energy efficient power semiconductor devices. In turn, SiC-based power conversion solutions can be made more energy efficient, smaller, lighter, cooler running, more rugged and reliable, and therefore be less costly and greener than any other charging option.
They minimize the size and weight of the charging station while maintaining a 30-minute-or-less charge time, which makes them easier to integrate into a variety of environments while getting closest to emulating the same experience that drivers have filling their tank with gas, whether it’s in their hometown or on a road trip. Most critically, SiC-based solutions are cost effective to build, install, maintain and utilize.

They also deliver efficiencies that reduce pressures on power grids with as much as 30% lower losses, which is important to both municipalities and fleet owners mindful of the utility bill that comes with building out a network of charging stations. A notable SiC advantage is 2% higher efficiency in an EV-charging system, which translates into more than 3 kW delivered to charge batteries that otherwise would be consumed by the charger itself on a 160-kW charger and a >50% increase in power density. Overall, the system cost is lower and requires less overall cooling, as well as smaller and cheaper mechanical housing with 30% few components.

Most of all, SiC-based solutions are ready for what fast EV-charging infrastructures will be in the future. Not only will they be able to deliver a great deal of power in a cost-effective manner, but they can easily and economically support bidirectionality that enables smart grid applications — if not today then tomorrow — as well as e-commerce capabilities for retailers who want to make it easy to pass on their power costs to the drivers who are charging up.

**Any fast EV-charging infrastructure must be future-proof**

Drivers, businesses, and municipalities can benefit from SiC-based solutions today, but if bi-directionality is to carry the day — and it likely will— then they will be required in the future.

SiC-based solutions offer flexibility and adaptability to help meet the growing demand for fast EV-charging infrastructure today, whether it’s a bidirectional charging station or not. Regardless, they are the best option in any scenario: delivering the most power, quickly, in the smallest form factor and at the lowest cost to make charging sufficiently universal so as to overcome any range anxiety that may be slowing EV adoption.