The transition to electric vehicles (EVs) is a critical component of global efforts to reduce carbon emissions and achieve sustainability goals. However, the rapid increase in EV adoption is placing significant stress on power grids, especially in regions with aging infrastructure or countries experiencing fast economic development.

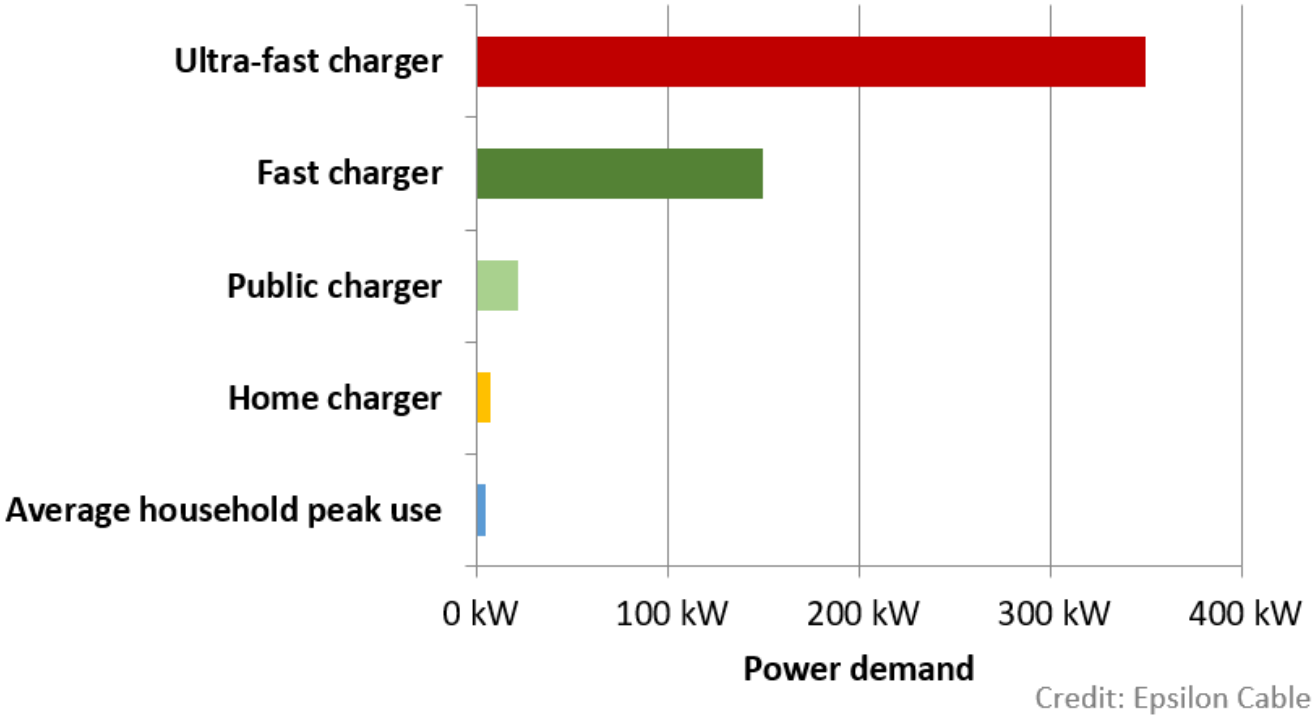
Charging stations—particularly fast chargers—draw a considerable amount of power, often comparable to that of a small industrial facility. As a result, many utilities are struggling to keep up with the rising energy demand. Grid congestion occurs when the existing transmission infrastructure cannot efficiently transport electricity to where it is needed, leading to voltage drops, power outages, increased transmission losses and possible sag violations posing serious safety issues. This problem is most pronounced during peak charging hours, typically in the evenings when people return home from work and plug in their vehicles.

An EV will typically increase a household electricity consumption by 20% to 75%. This means additional needs for generation, transmission and distribution, with distribution networks being the most severely affected.

However, not all chargers have the same impact and it is essential to differentiate between regular home chargers and fast chargers, which put an even higher strain on the grid

Home charging (7 kW) typically adds a moderate load to the grid but is often done overnight, when demand is lower.
On the contrary, **fast charging (50-350 kW) can place a substantial strain on the grid with a strong surge of power demand** for 10-30 minutes per vehicle, including during peak hours.

The addition of 10 fast chargers at 150 kW each means a potential peak demand jump of 1.5 MW, equivalent to 300-400 households running at peak power!



Credit: Epsilon Cable

Case studies: the impact of EV charging on power grids

Let’s take a look at some specific case studies from around the world:

Research examining **Texas**‘ power system in the context of expanded highway fast-charging (HFC) infrastructure has highlighted how the integration of a large-scale HFC network is expected to increase system average operational costs by up to $6 per MWh, particularly under scenarios of high EV penetration. A significant portion of these increased costs is attributed to transmission congestion on feeder lines serving a minority of HFC stations.

In **California**, a pioneer in EV adoption, a 2024 study by researchers at the University of California found that 67% of the feeder lines will require capacity upgrades by 2045, necessitating an estimated 25 GW in grid enhancements costing between $6 and $20 billion

Across Europe, in countries such as **Germany**, **Belgium** and **The Netherlands**, regulators and grid operators (both distribution and transmission) are engaged in massive infrastructure upgrade to scale electro mobility, and Composite Core Conductors have been widely adopted to enable the needed grid reinforcement.

In **India**, where it is expected that 30% of all vehicles will be electric by 2030, utilities are

massively installing Composite Core Conductors to keep local transmission and distribution lines from being overwhelmed by simultaneous charging of EVs—especially in dense urban centers.

In **Australia**, Ampol reported that approximately 100 of their EV charging bays across Australia and New Zealand are either awaiting grid connection or under construction.

In the **UK**, charging stations operators invested £500 million in the past 18 months, but delays of up to three years are reported due to the existing grid's capacity constraints and the time required for necessary upgrades.

The rollout of EV fast-charging infrastructure has been slower than anticipated in many other countries, primarily due to difficulties in securing grid connections.

Those cases emphasize the importance of **targeted infrastructure improvements** to mitigate localized congestion issues arising from concentrated fast-charging stations, for which advanced conductors such as **HVCRC®** provide an ideal solution.



How carbon core HTLS conductors can help solve grid congestion caused by EVs

To accommodate the increasing electricity demand from EVs, utilities must upgrade transmission networks without requiring extensive new infrastructure. One of the most effective

ways to achieve this is by deploying Carbon Core High-Temperature Low-Sag (HTLS) Conductors, which offer superior efficiency and capacity over traditional conductors.

Carbon Core HTLS conductors such as the HVCRC® offer 4 key benefits in this context:

- **Higher ampacity**: Carbon Core HTLS conductors can carry twice more current than conventional conductors, allowing utilities to handle EV charging loads without the need for entirely new transmission lines.
- **Faster grid upgrades**: Replacing existing wires with Carbon Core HTLS conductors (also called “reconductoring” or “advanced reconductoring”) can be done without replacing existing structures, making it a cost-effective solution for utilities facing EV-driven congestion.
- **Minimal line sag**: Traditional conductors experience sagging when operating at high temperatures, reducing clearance and causing inefficiencies. Carbon Core HTLS conductors, on the other hand have a much lower thermal expansion, even at very high temperature, so they can maintain proper clearance and improve safety.
- **Lower transmission losses**: Carbon Core HTLS conductors have a 30% lower electrical resistance, ensuring that more power reaches EV charging stations efficiently.

Future outlook

Whether or not the ambitious targets for EV adoption are met, the switch from Internal Combustion Engine vehicles to EVs poses a serious challenge on the electric grid.

As many countries explore options to alleviate grid congestion associated with increased EV adoption, most have opted for a three-pillar strategy:

- **Grid modernization**: Upgrading existing power lines with advanced conductors, such as HVCRC® Carbon Core High-Temperature Low-Sag (HTLS) conductors, can enhance transmission capacity without the need for entirely new infrastructure. HVCRC® conductors can carry higher current loads and exhibit minimal sag, maintaining efficiency even under increased demand.
- **Smart charging infrastructure**: Implementing smart charging stations that can manage and distribute the electrical load more evenly helps prevent localized grid overloads. These systems can schedule charging during off-peak hours and adjust charging speeds based on real-time grid capacity. Smart features such as the V2G technology can also contribute to the grid flexibility.

- **Renewable energy integration**: Incorporating renewable energy sources, such as solar and wind, into the grid can provide additional power supply to meet the increased demand from EVs. This approach not only supports grid stability but also aligns with environmental sustainability goals.

By implementing these strategies, utilities can ensure a reliable and resilient electric grid while supporting the energy transition.



About the Author, Vincent BU

Vincent has a strong background in finance, combined with a deep interest in energy and technology. Raised in a multicultural environment in Malaysia and educated in the United States, he has built an international career with experience spanning India and Japan. Since 2021, he joined Epsilon as Area Sales Manager, driving the adoption of advanced conductors across the Asia-Pacific region. Vincent is currently based in Tokyo, where he lives with his family.