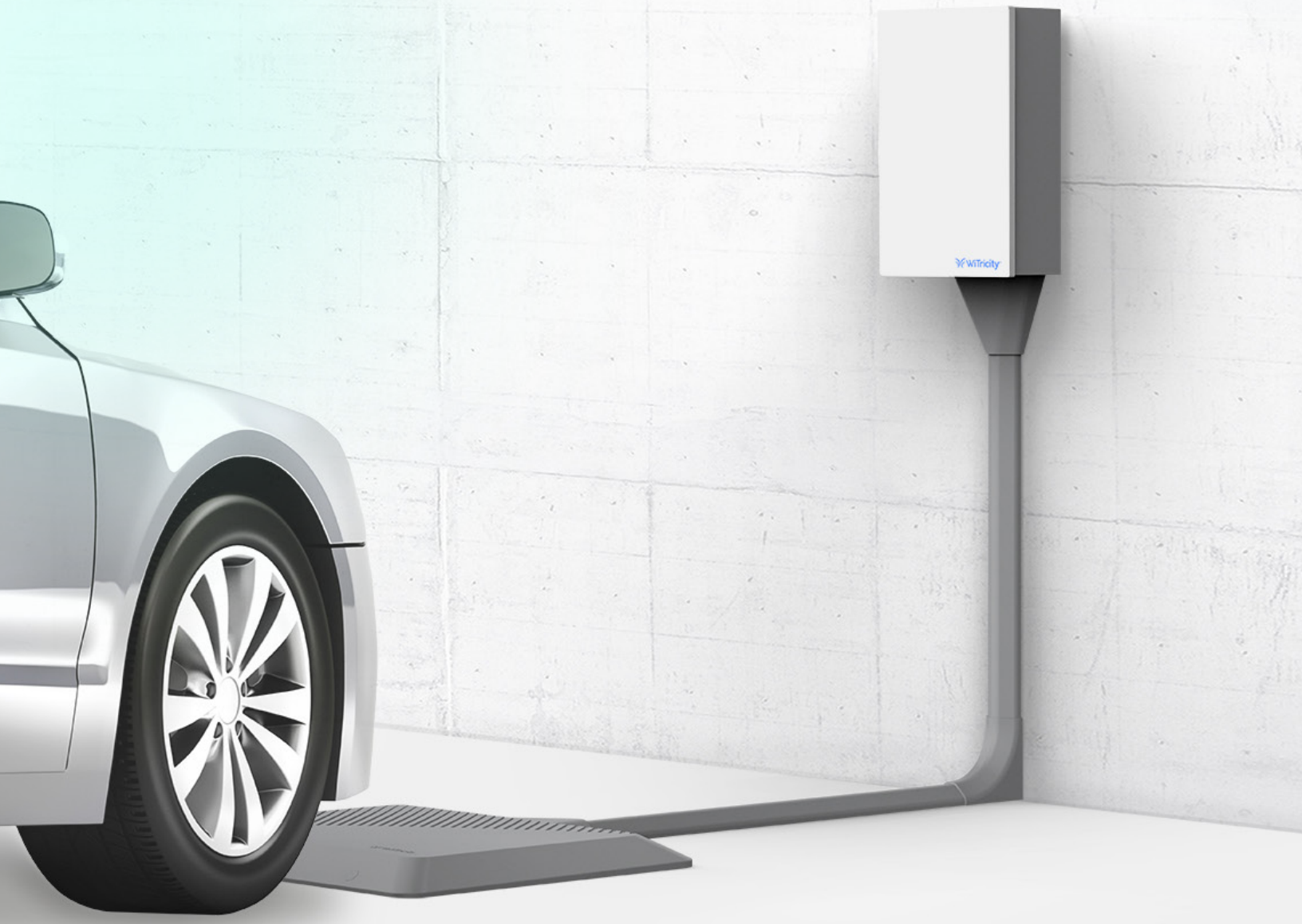
The Next Wireless Revolution:

Electric Vehicle Wireless Charging

Power and Efficiency



WiTricity®

The Next Wireless Revolution: Electric Vehicle Wireless Charging

The power and efficiency of wireless electric vehicle (EV) charging — and the future of electrified, shared, and autonomous transportation

Imagine never having to think about fueling your car. That day is here. In this world, cars charge themselves. The vehicle just gets the power it needs on its own, delivered wirelessly. There are no plugs or power cords, let alone trips to a gas or charging station.

Fast, safe and efficient wireless EV charging — an essential component of electric and autonomous transportation — is a technology that's proven and is being deployed.

Top off your battery by "power snacking" during the day – at work or running errands.

EV charging levels

According to SAE International, there are three basic levels of EV charging:

Level 1

"Slow" charging consists of standard 120 V (up to 20A) household wall plug charging, requiring 8 to 20 hours to charge a typical EV battery pack.

– Typically 4 miles of range per hour charging.

Level 2

"Fast" charging units use 240 V electricity (up to 80A), are rated from 3.3 kW up to 22 kW and can charge an EV in 4-7 hours.

– Typically 20-40 miles of range per hour charging at 11kW.

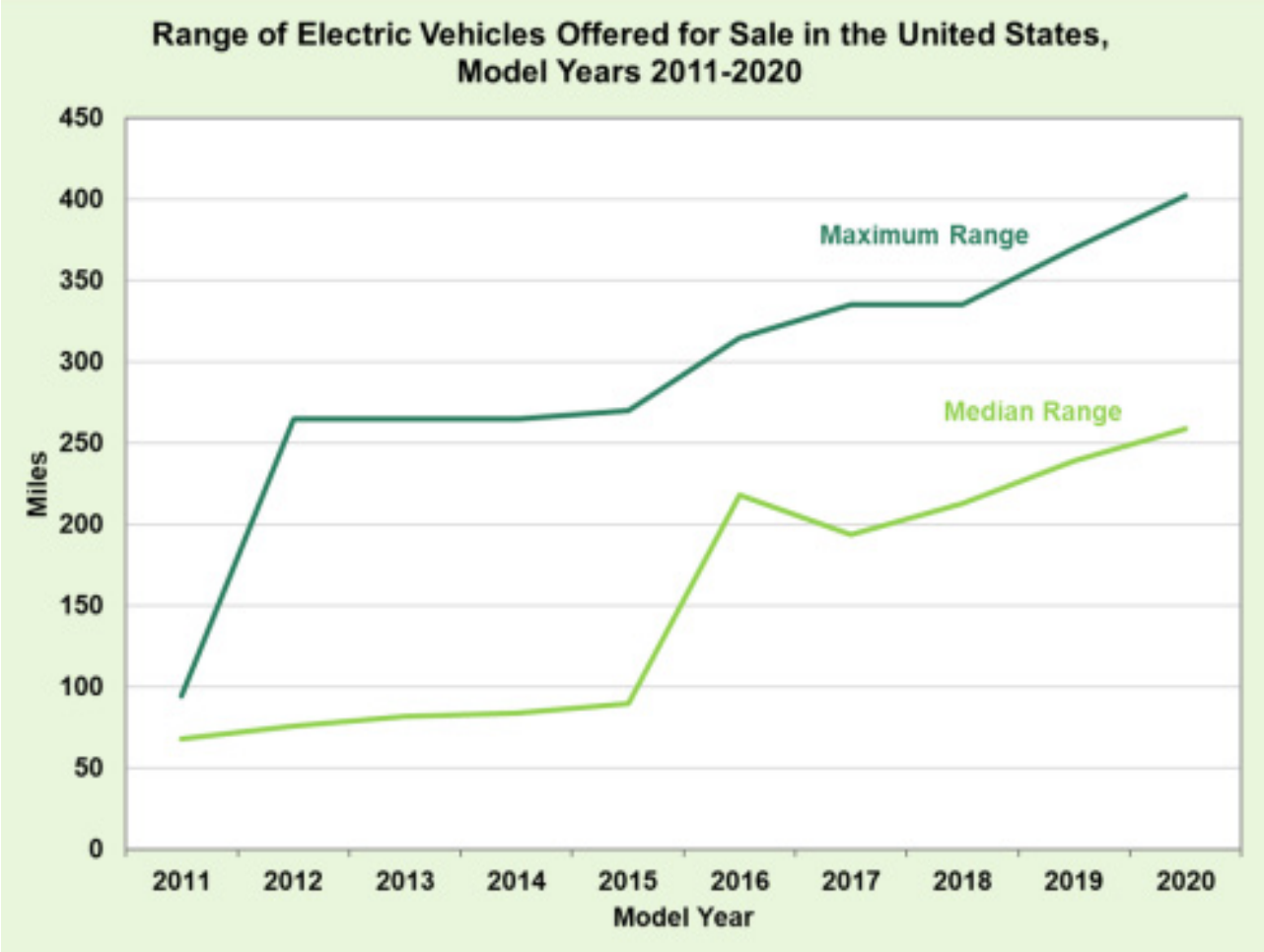
Level 3

"Rapid" charging (AC or DC) units use 480V AC input and are rated between 43 kW and 120 kW and require 20-30 minutes to charge an EV.

– Can charge at speeds over 200 miles of range per hour (depends on vehicle, charging equipment and battery level)

The speed and efficiency of wireless EV charging

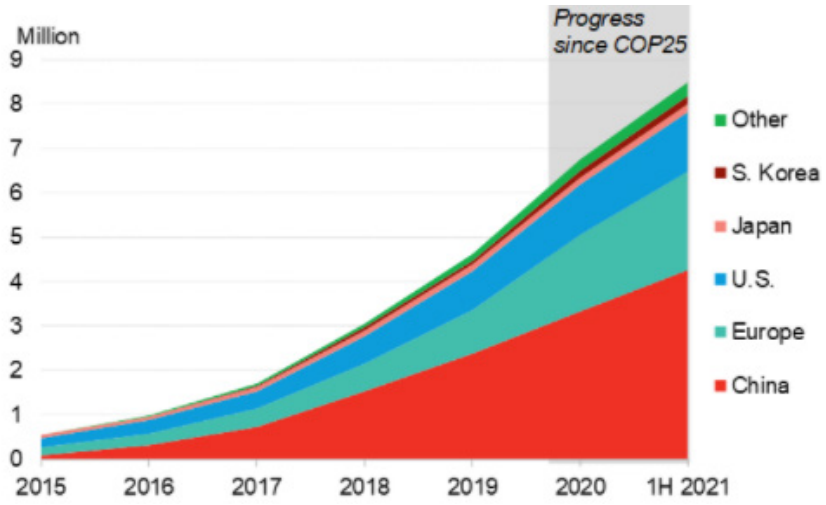
Electric vehicles are extending their range and market penetration every year. The median EPA estimated range for all EV models offered in the 2020 model year exceeded 250 miles, according to figures from the US Department of Energy (DOE). The 2020 model year also marked the first year that an EV achieved an EPA-estimated maximum range of more than 400 miles.



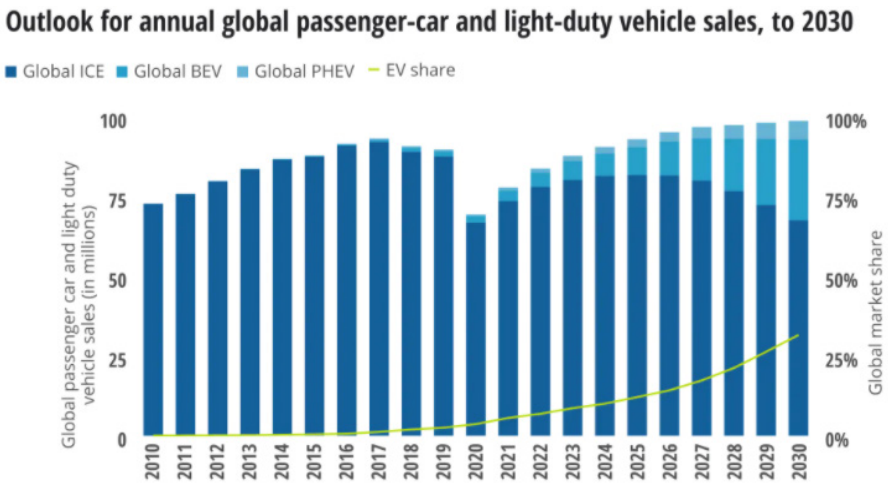
Source: US Department of Energy and U.S. Environmental Protection Agency, Fuel Economy website.

In addition, regulations are helping drive EV adoption — along with a rapidly increasing consumer demand. In California, whose regulations set the standard for U.S. automakers, the state's Zero Emission Vehicle program mandates 8% of new cars sold by 2025 to be EVs; it currently accounts for more than 25% of the country's EVs. More than a dozen countries, mostly in Europe, have proposed a timeline to phase out new sales of fossil fuel passenger cars or to only sell zero-emission models by 2050. Among them, Norway has the most ambitious target, aiming to achieve a 100% electric vehicle share of new passenger vehicle and light-duty van sales by 2025.

[International Council on Clean Transportation]



Source: BloombergNEF. Note: ZEVs only include battery electric vehicles (BEVs) and fuel cell vehicles (FCVs).



Source: Deloitte Analysis, HIS Markit, EV-Volumes.com

In all, the future of personal transportation will increasingly be built around the EV, which means being more and more reliant on EV charging.

Consumers who buy EVs today typically buy plug-in charging stations for their home or office. Most, however, do not realize that the time it takes to fully recharge will be the same with either a wired or wireless charger.

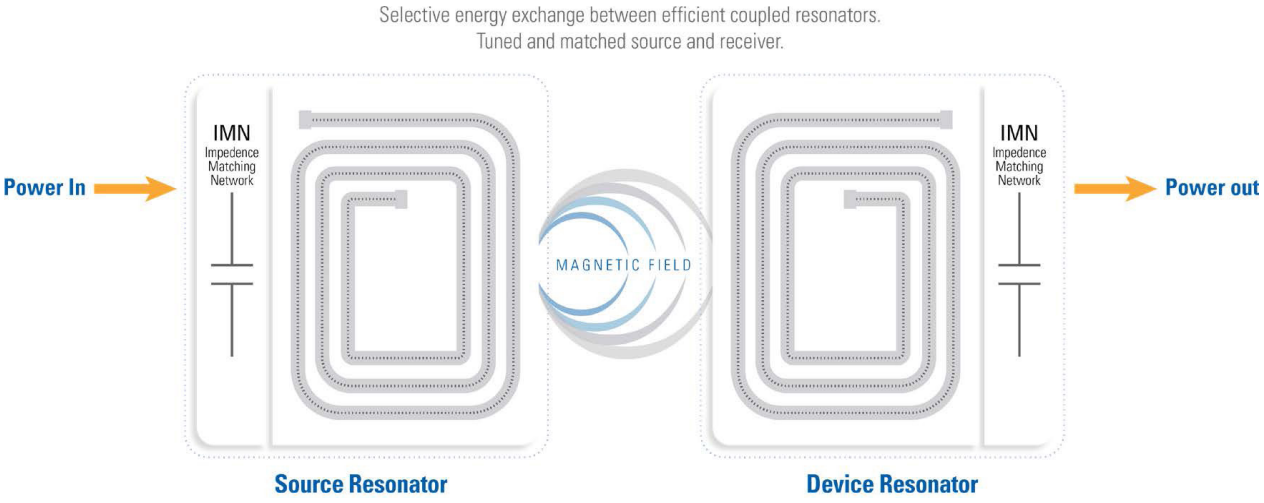
Most consumer plug-in EV chargers — whether Level 1 or Level 2 (see sidebar on page 2) — operate in the 88% to 95% efficiency range. Leading wireless EV charging technologies today operate in the upper end of that same range — at between 90% to 93% efficiency.

WiTricity wireless charging is based on an improvement upon the physical principle of electromagnetic induction. Induction has long been used in household appliances like induction cooktops, charging electric toothbrushes, and even some smartphones.

Yet, the remarkable fact that Electric Vehicle wireless charging can be as efficient as plugging in stems not from induction alone. One additional technological layer is needed: the innovation of magnetic resonance.

In 2007 a group from MIT published the results of an experiment demonstrating that the use of magnetic resonance enables efficient wireless power transfer across mid-range distances. Using coupled magnetic resonators they powered a 60 Watt light bulb over a distance of 2 meters, a result that received worldwide attention.

By tuning both the transmitter and receiver to an equivalent resonant frequency, the system becomes significantly more efficient while also allowing for transmission distances that are far more practical than traditional induction permits.

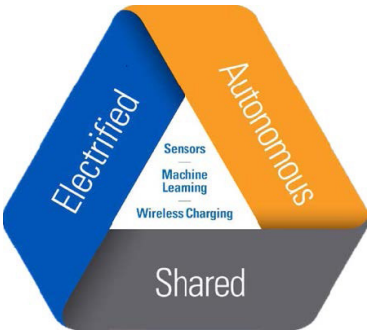


WiTricity technology provides a unique solution for medium and high power requirements.

Today the commercial outgrowth of that technology — known as magnetic resonance or, equivalently, highly resonant wireless power transfer — represents the core of WiTricity's EV wireless charging system. Independent testing at the US Department of Energy's Idaho National Laboratory, as part of the J2954 standard developed by SAE International proved the superior performance and interoperability of WiTricity's system. The efficient design and architecture is also considered the global standard by IEC, ISO and China GB Standards.

Moreover, WiTricity's wireless charging technology is safe. EV charging using WiTricity technology at even 11 kW meets all regulatory guidelines for human safety.

Park and charge wirelessly and autonomously.



Economic and practical considerations of wireless EV charging

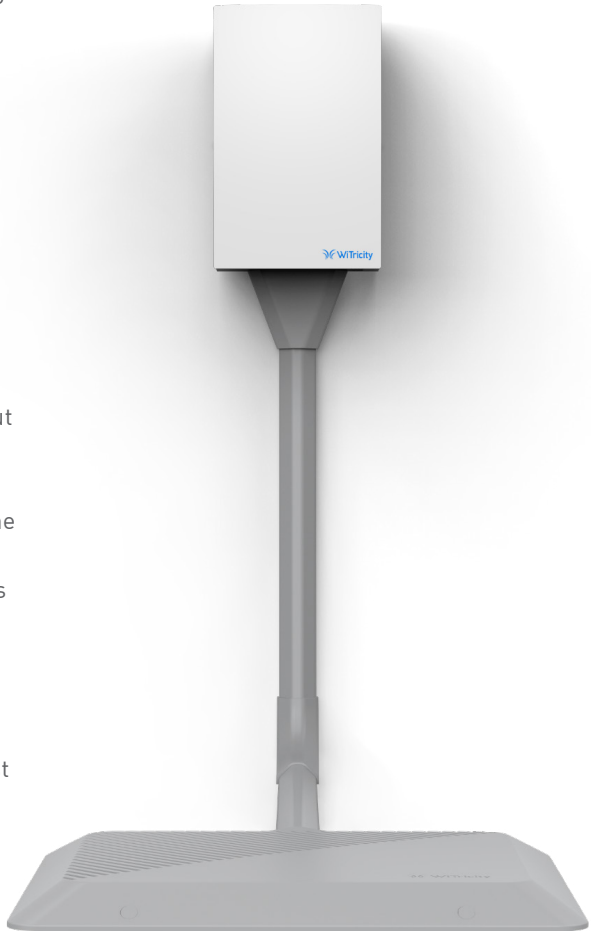
It's easy to forget how much time and effort people spend throughout their lives keeping their cars' gas tank filled. Yet imagine a hassle-free technology that filled your car every night while you slept, and you didn't even need to plug it in. How much of a premium would you be willing to pay never to have to worry about filling or charging your car?

The question is not merely one of convenience either. Wireless EV charging also represents a step forward in safety. In a torrential downpour or severe thunderstorm, would you prefer to wirelessly charge your car without a second thought, or would you rather get soaked as you fumble around with a 480-Volt DC Fast Charging cable?

Wireless charging, to be clear, is just as convenient and safe out in the elements as it is inside a garage.

Wireless EV charging ultimately represents a new way of thinking about transportation. People aren't used to putting their car in the same category as their household appliances — whose power sources are effectively invisible and out-of-mind. Unless there's a power outage, the refrigerator or dishwasher just run without any second thought paid to their power source. So too, with wireless EV charging, the car becomes a little bit more like a household appliance — at least in terms of its power sourcing.

In other words, wireless charging is something that happens in the background, when the car is parked over wireless charging pads. It just charges itself, and on a typical day's driving, one doesn't need to think about power sourcing and battery levels.



References

[1] “Fact of the Week #1008,” U.S. Dept. of Energy, Dec. 18, 2017

[2] Reichmuth, David. “What Will It Take for Automakers to Meet California’s EV Requirements? Not as Much as You Might Think.” Union of Concerned Scientists, Apr. 26, 2017

[3] “Regional Charging Infrastructure for Plug-In Electric Vehicles: A Case Study of Massachusetts” by Eric Wood et al, NREL. Jan. 2017
https://www.nrel.gov/docs/fy17osti/67436.pdf

WiTricity is the global industry leader in wireless charging, powering a sustainable future of mobility that is electric and autonomous. WiTricity’s patented magnetic resonance technology is being incorporated into global automakers’ and Tier 1 suppliers’ EV roadmaps and is the foundation of major global standards developed to support wide-scale adoption. Advancements like dynamic charging of moving vehicles, and the charging of autonomous robots and vehicles without human intervention all depend on WiTricity technology. See how WiTricity enables a magically simple, efficient charging experience.