AWL-Electricity

All WireLess Electricity

ONE VISION. ZERO WIRES.

COMPETITIVE TECHNOLOGIES OVERVIEW

Wireless Power Technologies

Radio Frequency (RF) uses converging beams in the GHz range to deliver energy over distances up to 10 meters. It requires a direct line of sight and operates in the milliwatt (mW) range to remain within safety and regulatory limits for human exposure.

Inductive coupling, the current industry standard, uses magnetic fields between two coils. While effective, it is limited to millimeter-scale distances and requires precise alignment. Nearby metallic objects also pose a safety risk due to heat generated by eddy currents.

Capacitive coupling transfers power via electric fields between metal electrodes. It can penetrate non-metallic barriers (like furniture or walls) and is less affected by nearby metal than inductive systems. However, its efficiency drops sharply as the distance increases.

Resonance enhances inductive or capacitive systems by matching the natural frequencies of the transmitter and receiver. By using compensation networks to cancel reactance, the system achieves a high Quality Factor (Q), significantly extending range and "spatial freedom." This became commercially viable around 2015 with Gallium Nitride (GaN) FETs, which enable the high-frequency MHz switching required for efficient transfer.

DIFFERENT TECHNOLOGIES OVERVIEW

Wireless Power Technologies

Feature	Radio Frequency	Inductive	Capacitive	Resonant Inductive	Resonant Capacitive
Field Type	Electromagnetic Waves GHz (Far-Field)	Magnetic KHz (Near-Field)	Electric kHz (Near-Field)	Magnetic kHz (Near-Field)	Electric MHz (Near-Field)
Typical Range	Long (m to km)	Very Short (1–10mm)	Very Short (1–10mm)	Mid-Range (cm to m)	Mid-Range (cm to m)
Power Level	Very Low (μW to mW)	Medium (W)	Medium (W)	High (W to kW)	High (W to kW)
Alignment Tolerance	Flexible (Omni or Beam)	Low (Very Precise Location)	Medium (Must Overlap)	Medium (Precise Location)	Flexible (Spatial Freedom)
Metal Tolerance	Low (Line of Sight)	Low (Heat Nearby Metal)	High (Pass Through Metal)	Low (Heat Nearby Metal)	High (Pass Through Metal)
Patent Landscape	Saturated	Saturated	Saturated	Saturated	Early
Reference	Energous, Aeterlink	Qi Standard	Murata	WiTriCity, InductEV	AWL-E, Cornell

AWL-ELECTRICITY’S TECHNOLOGY

Resonant Capacitive Coupling

AWL-Electricity utilizes a high-frequency resonant architecture designed to overcome the efficiency and integration limitations of traditional wireless power systems. The technology is built on three core pillars: GaN-driven power conversion, high-frequency operation, and integrated resonating cell design. It is continually being improved by the R&D team constituted of physicists and engineers.

GaN-Driven Power Electronics
The system leverages Gallium Nitride (GaN) FETs rather than conventional Silicon MOSFETs. The inherent material properties of GaN, specifically superior electron mobility, enable critical performance advantages:

- **Reduced Switching Losses:** Ultra-low Gate Charge and near-zero Reverse Recovery minimize hard-switching losses.
- **Thermal Stability:** Eliminates the thermal runaway common in Silicon components when operating at MHz frequencies.
- **ZVS Topology:** Inverter designs utilize Zero Voltage Switching (ZVS). By ensuring transitions occur at zero voltage, "turn-on" losses are virtually eliminated and dv/dt is significantly reduced.

High-Frequency Operation (6.78 MHz ISM Band)
Operation at 6.78 MHz, significantly higher than the 100–200 kHz range of standard Qi or industrial inductive systems, provides two primary benefits:

- **High Power Density:** High-frequency operation allows for a significant reduction in the physical size of passive components (inductors and capacitors), resulting in a smaller system footprint and higher power-to-weight ratios.
- **Global Compliance:** Operation within the Industrial, Scientific, and Medical (ISM) band ensures global regulatory alignment. Furthermore, ZVS operation suppresses radiated emissions at the source and simplifies EMC certification.

Resonating Cell Design
The resonating cell is engineered to maintain high efficiency in "metal-heavy" or complex constraints.

- **Integration and Retrofitting:** The technology allows for seamless incorporation into existing product architectures by utilizing the existing structure and materials. This includes mounting electrodes directly onto available surfaces or repurposing internal metallic components to function as part of the circuit.

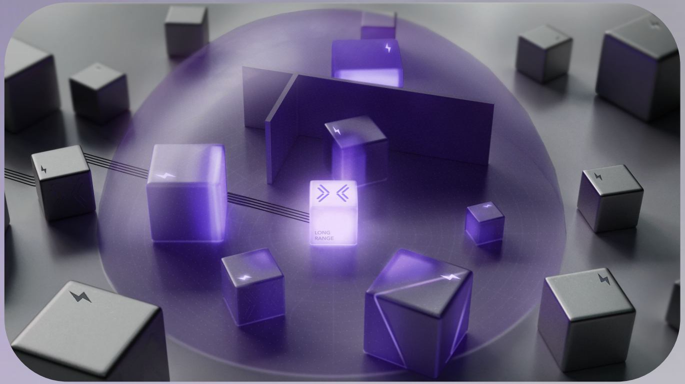
SYSTEM 1

Long-Range System

The long-range system is central to AWL-Electricity's strategy. Through discussions with industry leaders such as Samsung and Sony, it has become clear that **AWL-E is the only company with the technical capability to deliver it.**

This system is designed to deliver power over longer distances (up to ~1 meter or more depending on the configuration) across air gaps and in metal-heavy environments. It is specifically engineered to function even when the receivers are integrated within or shielded by large metallic structures. By eliminating cable harnesses, this system enables power delivery to previously inaccessible or cost-prohibitive locations. This wireless approach facilitates innovative product design and enhances the user experience through seamless, long-range charging.

Use Cases: Sensors, Cameras, Controllers, Embedded Computers, Monitoring Modules, Low-Power Edge/AI Devices



Benefits / How it differs

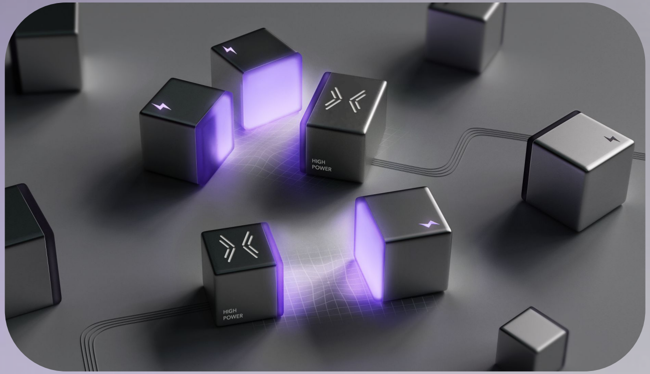
- Operates in metal-heavy environments and complex mechanical structures, where conventional wireless power and wires cannot deliver power
- Sends multiple watts of power at more than 1 meter with no line of sight

Current Trade-offs / Limitations

- Power decreases with distance and geometry: typically ~5 W at long range; up to ~15 W at shorter range
- Efficiency is application-dependent: can reach up to ~80% in favorable conditions, but decreases with large air gaps and difficult geometries

SYSTEM 2

High-Power System



The high-power system targets powering or charging larger loads, similar to the industrial wireless charging. The capacitive approach allows for a larger active transmission area. This enables creating continuous charging zones or highways where robots can charge while in operation. By eliminating dedicated charging downtime, this technology significantly increases operational ROI.

Use Cases: Small Vehicles, AGVs, Humanoids, Robotic Arms, Electric Motors

Benefits / How it differs

- Allows flexible positioning compared with inductive systems that require tight alignment over a precise charging point
- Enables dynamic charging over a larger active transmission area, turning battery into a backup system

Current Trade-offs / Limitations

- AWL-Electricity currently focuses on applications under ~1.2 kW
- A new charger design typically requires a few months of engineering to finalize power management, safety, and interfacing with the target battery system and device electronics