Today, even the most advanced wireless devices are designed to be periodically tethered to their rechargers with a power cord. In the near future, however, all your wireless devices—phone, laptop, Bluetooth headset, remote controls, game joysticks and more—will be powered by energy beacons that will beam directly to devices, effectively cutting the last power cord. Even light bulbs will eventually be powered wirelessly.

Nikola Tesla pondered the dream of wireless energy transfer as long ago as 1899, but only recently has the concept become technologically feasible, according to Massachusetts Institute of Technology professor Marin Soljacic. In 2007, Soljacic demonstrated how resonant magnetic coupling can wirelessly transfer energy. His work inspired Intel’s 2008
demonstration of a wirelessly illuminated light bulb.

Intel, which likens the technique to a singer’s breaking a glass by hitting a pitch that matches the resonant frequency of the glass, has discovered that resonant coupling works best at an optimal distance—a “sweet spot.” Details will appear in next month’s *IEEE Transactions on Industrial Electronics*.

“Intuitively, you would think that the closer the coils, the more efficient the coupling,” said Intel Research principal engineer Joshua Smith. “Not true. Depending on the size of the coil and the frequency being used, there is an optimal distance where very high efficiency is achieved.”

Intel is investigating how to tune the coupling in real-time in order to keep wirelessly powered devices in the sweet spot, with an eye toward developing control systems that would automatically ensure optimal resonant coupling.

MIT’s Soljacic, whom Intel cites in its research, has founded a company, WiTricity Corp. (Watertown, Mass.), that has licensed its patented technology to about two dozen OEMs. Some of the licensees plan to introduce products later this year. Most are concentrating on recharging apps for mobile consumer devices, but some WiTricity licensees are aiming higher. At this year’s Consumer Electronics Show, for example, Haier Group (Qingdao, China) demonstrated an untethered
32-inch flat panel TV that wirelessly received both HDMI data and WiTricity power.

“Our OEMs run the gamut from consumer electronics to industrial and military applications,” said WiTricity CEO Eric Giler. “At the low end of the power spectrum, there are all these mobile devices that need to be recharged, as well as low-power devices that use disposable batteries—like keyboards and mice, for example—that we can power wirelessly. And at the high end, we have been able to deliver 3 kW to a plug-in electric automobile.”

WiTricity hopes to offer solutions for every device type that uses batteries today—and, like Intel, it aspires to cast wireless energy transfer into silicon.

“We are actively engaged with a number of chip manufacturers who are planning to produce WiTricity-enabled chips,” said Giler. “These well-known semiconductor companies will put everything an OEM needs onto one chip, except for the resonator and some of the power electronics.”

Several other patented technologies will compete with resonant magnetic coupling. Duracell’s myGrid, using technology licensed from WildCharge, cleverly arranges a conductive grid so that it will always match the electrode spacing of the user-added “warts” on a mobile device. Lay down a wart-equipped mobile device anywhere on the pad, and its electrodes will
make contact and begin charging, enabling wireless power transfer from the myGrid electrode to the wart electrode at almost 100 percent efficiency.

Also already in the marketplace are inductive charging pads made by Powermat USA (Commerce Township, Mich.), a joint venture between Michigan-based HoMedics and Israel’s PowerMat Ltd.

“We now have over 40 patents applied for and are achieving from 80 to 92 percent efficiency,” said Powermat vice president David Kelly. “We are working on solutions that transmit both the power and the data to devices wirelessly, and we have aspirations to recharge electric cars someday too.”

Powermat’s inductive technology works much as a transformer does: Coils of wire on the transmit side set up a magnetic field that induces a current in the receiver’s coil, which is attached to its battery. Mobile phone users merely replace their existing battery and door with a Powermat version that includes the receiver coil from which current is induced by the transmit
coil in the Powermat. The upside is the relatively high efficiencies that can be achieved with wireless power transfer by induction, but the downside is that mobile devices have to be positioned with millimeter precision to achieve those high efficiency marks.

Powermat claims to have delivered more than 750,000 units since introducing its technology late last year. Those kinds of numbers have attracted rivals, principally Fulton Innovation (Ada, Mich.), whose eCoupled technology also uses inductive coupling.

Fulton claims its approach is superior because it includes an intelligent resonant frequency tuning system that optimizes power transfers in real-time to achieve up to 98 percent efficiency. Fulton has attracted such big-name partners as Bosch, Energizer, Motorola and Texas Instruments.

For a roundup of companies working on inductive wireless power technologies, visit the Wireless Power Consortium, a trade group whose 30-plus members are working toward an open standard.

Another promising method for wirelessly powering household devices uses near-infrared laser diodes. According to developer PowerBeam Inc. (Mountain View, Calif.), the invisible, eye-safe power beams can be precisely aimed at devices, such as wall-mounted TVs, to eliminate unsightly cords. On the receiving end, a solar-cell like receiver converts the incident laser beam.
into electricity.

“We use long-IR laser diodes on the transmit side that can be beamed over long distances, up to 30 feet,” said PowerBeam co-founder Christopher Surdi.

PowerBeam offers three evaluation kits for designing real applications: a 100-mW kit for sensors, a 2.5-W kit for small mobile devices and a 10-W kit for powering appliances. The company targets OEMs that develop wireless sensors, keyboards, mice, mobile phones, speakers, TVs and signage.

Its systems are completely safe, according to Surdi, because they automatically turn off whenever the beam is interrupted.

Another wireless power transfer method taps RF to achieve distances as far as PowerBeam’s but without requiring line-of-sight connections. Powercast Corp. (Pittsburgh) says its Powerharvester receiver chips can either recharge batteries or eliminate them altogether. A single RF power beacon can transfer energy to any number of receiver chips within its broadcast range, which can be hundreds or even thousands of feet.

The downside of RF is that FCC regulations cap transmitters at 5 W. That restriction, in turn, limits the amount of power transferrable to devices to the milliwatt range.

As a result, the RF approaches are suitable only for specialized applications such as wireless sensor networks.