Wireless energy transfer:

Wireless power transmission is the transmission of electrical energy from a [power source](http://en.wikipedia.org/wiki/Power_supply) to an [electrical load](http://en.wikipedia.org/wiki/Electrical_load) without interconnecting [wires](http://en.wikipedia.org/wiki/Wire). Wireless transmission is useful in cases where interconnecting wires are inconvenient, hazardous, or impossible. The problem of wireless [power transmission](http://en.wikipedia.org/wiki/Electric_power_transmission) differs from that of wireless [telecommunications](http://en.wikipedia.org/wiki/Telecommunications), such as [radio](http://en.wikipedia.org/wiki/Radio). In the latter the proportion of [energy](http://en.wikipedia.org/wiki/Power_%28physics%29) received becomes critical only if it is too low for the signal to be distinguished from the background [noise](http://en.wikipedia.org/wiki/Signal_to_noise_ratio).[[1]](http://en.wikipedia.org/wiki/Wireless_energy_transfer#cite_note-0) With wireless power, efficiency is the more significant parameter.  A large part of the energy sent out by the generating plant must arrive at the receiver or receivers to make the system economical.

Types of energy transfer:

* Near field techniques:
* Far field techniques:

Near field techniques:

* Inductive coupling

The [electro dynamic induction](http://en.wikipedia.org/wiki/Electrodynamic_induction) wireless transmission technique is [near field](http://en.wikipedia.org/wiki/Near_and_far_field) over distances up to about one-sixth of the wavelength used. Near field energy itself is non-radiative but some radiative losses do occur. In addition there are usually resistive losses. With electro dynamic induction, electric current flowing through a [primary coil](http://en.wikipedia.org/wiki/Primary_coil) creates a [magnetic field](http://en.wikipedia.org/wiki/Magnetic_field) that acts on a secondary coil producing a current within it. Coupling must be tight in order to achieve high efficiency. As the distance from the primary is increased, more and more of the magnetic field misses the secondary. Even over a relatively short range the inductive coupling is grossly inefficient, wasting much of the transmitted energy.[[13]](http://en.wikipedia.org/wiki/Wireless_energy_transfer#cite_note-12)

This action of an electrical [transformer](http://en.wikipedia.org/wiki/Transformer) is the simplest form of wireless power transmission. The primary and secondary circuits of a transformer are not directly connected. Energy transfer takes place through a process known as [mutual induction](http://en.wikipedia.org/wiki/Mutual_induction). Principal functions are stepping the primary voltage either up or down and electrical isolation. [Mobile phone](http://en.wikipedia.org/wiki/Mobile_phone) and [electric toothbrush](http://en.wikipedia.org/wiki/Electric_toothbrush) [battery chargers](http://en.wikipedia.org/wiki/Battery_charger), and electrical power distribution [transformers](http://en.wikipedia.org/wiki/Transformer) are examples of how this principle is used. [Induction cookers](http://en.wikipedia.org/wiki/Induction_cooker) use this method. The main drawback to this basic form of wireless transmission is short range. The receiver must be directly adjacent to the transmitter or induction unit in order to efficiently couple with it.

Resonant inductive coupling:

**Resonant inductive coupling** or **electrodynamic induction** is the [near field](http://en.wikipedia.org/wiki/Near_and_far_field) [wireless transmission of electrical energy](http://en.wikipedia.org/wiki/Wireless_energy_transfer) between two coils that are highly [resonant](http://en.wikipedia.org/wiki/Electrical_resonance) at the same frequency.  The equipment to do this is sometimes called a **resonant or resonance transformer**.

Non-resonant [coupled inductors](http://en.wikipedia.org/wiki/Coupled_inductors), such as typical [transformers](http://en.wikipedia.org/wiki/Transformer), work on the principle of a [primary coil](http://en.wikipedia.org/wiki/Primary_coil) generating a [magnetic field](http://en.wikipedia.org/wiki/Magnetic_field) and a secondary coil subtending as much as possible of that field so that the power passing though the secondary is as close as possible to that of the primary. This requirement that the field be covered by the secondary results in very short range and usually requires a [magnetic core](http://en.wikipedia.org/wiki/Magnetic_core). Over greater distances the non-resonant induction method is highly inefficient and wastes the vast majority of the energy in resistive losses of the primary coil.

Using resonance can help efficiency dramatically. If resonant coupling is used, each coil is capacitively loaded so as to form a tuned [LC circuit](http://en.wikipedia.org/wiki/LC_circuit). If the primary and secondary coils are resonant at a common frequency, it turns out that significant power may be transmitted between the coils over a range of a few times the coil diameters at reasonable efficiency

Air ionisation:

The intense electric field on the surface of power line cables is sufficient to ionise the air, producing corona ions. This process is the cause of the characteristic buzzing or crackling of power lines. Corona ions are routinely emitted from high voltage power lines, especially in wet conditions. Corona ion effects have been measured up to 7 kilo metres from power lines both in the UK and in Germany. Corona ions are small electrically-charged particles which, when emitted from power lines attach themselves to particles of air pollution, making these particles more likely to be trapped in the lung when inhaled. This phenomenon is sufficiently well recognised that pharmaceutical companies making inhalers are developing methods of charging up those aerosols to improve their effectiveness.

Advantages of near field techniques:

* No wires
* No e-waste
* Need for batteries are eliminated
* Efficient energy transfer using RIC
* Maintenance cost is less
* Harmless, under safety levels

Disadvantages of near field techniques:

* Distance constraint
* Initial cost is high
* Field strength has to be under safety levels
* In RIC, tuning is difficult
* High frequency signals should be the supply
* Air ionization techniques is not feasible

Far field techniques:

* LASER
* Microwave

Advantages of far field techniques:

* It is efficient and low maintenance cost
* Need for power grids and sub stations can eliminated
* More effective when transmitting and receiving points are along the line of sight
* Energy can be transmitting to remote places easily
* Disadvantages of far field techniques:
* It is radiative
* When LASERS are used, conversion is inefficient due to absorption losses.
* When microwaves are used, interference may arise

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Applications:

* **Direct Wireless Power**—when all the power a device needs is provided wirelessly, and no batteries are required. This mode is for a device that is always used within range of its *WiTricity* power source.
* **Automatic Wireless Charging**—when a device with rechargeable batteries charges itself while still in use or at rest, without requiring a power cord or battery replacement. This mode is for a mobile device that may be used both in and out of range of its *WiTricity* power source.

**Consumer Electronics**

* Automatic wireless charging of mobile electronics (phones, laptops, game controllers, etc.) in home, car, office, Wi-Fi hotspots … while devices are in use and mobile.
* Direct wireless powering of stationary devices (flat screen TV’s, digital picture frames, home theater accessories, wireless loud speakers, etc.) … eliminating expensive custom wiring, unsightly cables and “wall-wart” power supplies.
* Direct wireless powering of desktop PC peripherals: wireless mouse, keyboard, printer, speakers, display, etc… eliminating disposable batteries and awkward cabling.

**Industrial**

* Direct wireless power and communication interconnections across rotating and moving “joints” (robots, packaging machinery, assembly machinery, machine tools) … eliminating costly and failure-prone wiring.
* Direct wireless power and communication interconnections at points of use in harsh environments (drilling, mining, underwater, etc.) … where it is impractical or impossible to run wires.
* Direct wireless power for wireless sensors and actuators, eliminating the need for expensive power wiring or battery replacement and disposal.
* Automatic wireless charging for mobile robots, automatic guided vehicles, cordless tools and instruments…eliminating complex docking mechanisms, and labor intensive manual recharging and battery replacement.

**Transportation**

* Automatic wireless charging for existing electric vehicle classes: golf carts, industrial vehicles.
* Automatic wireless charging for future hybrid and all-electric passenger and commercial vehicles, at home, in parking garages, at fleet depots, and at remote kiosks.
* Direct wireless power interconnections to replace costly vehicle wiring harnesses and slip rings.