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Excepts from Wikipedia.

A **grid-tie inverter** is a power inverter that converts direct current (DC) electricity into alternating current (AC) with an ability to synchronize to interface with a utility line. Its applications are converting DC sources such as solar panels or small wind turbines into AC for tying with the grid.[1]

Residences and businesses that have a grid-tied electrical system are permitted in many countries to sell their energy to the utility grid. Electricity delivered to the grid can be compensated in several ways. "Net metering" is where the entity that owns the renewable energy power source receives compensation from the utility for its net outflow of power. So for example, if during a given month a power system feeds 500 kilowatt-hours into the grid and uses 100 kilowatt-hours from the grid, it would receive compensation for 400 kilowatt-hours. In the US, net metering policies vary by jurisdiction. Another policy is a feed-in tariff, where the producer is paid for every kilowatt hour delivered to the grid by a special tariff based on a contract with distribution company or other power authority.

In the United States, grid-interactive power systems are covered by specific provisions in the National Electric Code, which also mandates certain requirements for grid-interactive inverters.

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Typical operation[edit source | editbeta]

Inverters take DC power and invert it to AC power so it can be fed into the electric utility company grid. The grid tie inverter must synchronize its frequency with that of the grid (e.g. 50 or 60 Hz) using a local oscillator and limit the voltage to no higher than the grid voltage. A high-quality modern GTI has a fixed unity power factor, which means its output voltage and current are perfectly lined up, and its phase angle is within 1 degree of the AC power grid. The inverter has an on-board computer which will sense the current AC grid waveform, and output a voltage to correspond with the grid. However, supplying reactive power to the grid might be necessary to keep the voltage in the local grid inside allowed limitations. Otherwise, in a grid segment with considerable power from renewable sources voltage levels might rise too much at times of high production, i.e. around noon.

Grid-tie inverters are also designed to quickly disconnect from the grid if the utility grid goes down. This is an NEC requirement[2] that ensures that in the event of a blackout, the grid tie inverter will shut down to prevent the energy it transfers from harming any line workers who are sent to fix the power grid.

Properly configured, a grid tie inverter enables a home owner to use an alternative power generation system like solar or wind power without extensive rewiring and without batteries. If the alternative power being produced is insufficient, the deficit will be sourced from the electricity grid.

Technology[edit source | editbeta]

Grid-tie inverters that are available on the market today use a number of different technologies. The inverters may use the newer high-frequencytransformers, conventional low-frequency transformers, or without transformer. Instead of converting direct current directly to 120 or 240 volts AC, high-frequency transformers employ a computerized multi-step process that involves converting the power to high-frequency AC and then back to DC and then to the final AC output voltage.[3] Transformerless inverters, lighter and more efficient than their counterparts with transformers, are popular in Europe. However, transformerless inverters have been slow to enter the US market because historically there have been concerns about having transformerless electrical systems feeding into the public utility grid. This is due to the lack of galvanic isolation between the DC and AC circuits could allow the passage of dangerous DC faults to be transmitted to the AC side.[4] However, since 2005, the NFPA's NEC allows transformerless (or non-galvanically) inverters by removing the requirement that all solar electric systems to be negative grounded and specifying new safety requirements. The VDE 0126-1-1 and IEC 6210 also have been amended to allow and define the safety mechanisms needed for such systems. Primarily, residual or ground current detection is used to detect possible fault conditions. Also isolation tests are performed to ensure DC to AC separation.

Most grid-tie inverters on the market include a maximum power point tracker on the input side that enables the inverter to extract a maximum amount of power from its intended power source. Since MPPT algorithms differ for solar panels and wind turbines, specially made inverters for each of these power sources are available.

A vast amount of offers come from China, where two kinds of grid tied inverters (also called "grid tie inverter") are sold. At least one design allowing the inverter to be plugged into the mains is not fit for purpose assuming constant full solar power input. Those units will not work properly in part load, because they drag down the voltage below the operating range.

Characteristics[edit source | editbeta]

Inverter manufacturers publish datasheets for the inverters in their product line. While the terminology and content will vary by manufacturer, datasheets generally include the information listed below.

- *Rated output power*: This value will be provided in watts or kilowatts. For some inverters, they may provide an output rating for different output voltages. For instance, if the inverter can be configured for either 240 VAC or 208 VAC output, the rated power output may be different for each of those configurations.
- *Output voltage(s)*: This value indicates to which utility voltages the inverter can connect. For smaller inverters that are designed for residential use, the output voltage is usually 240 VAC. Inverters that target commercial applications are rated for 208, 240, 277, 400, or 480 VAC and may also produce three phase power.
- *Peak efficiency*: The peak efficiency represents the highest efficiency that the inverter can achieve. Most grid-tie inverters on the market as of July 2009 have peak efficiencies of over 94%, some as high as 96%. The energy lost during inversion is for the most part converted into heat. This means that in order for an inverter to put out the rated amount of power it will need to have a power input that exceeds the output. For example, a 5000 W inverter operating at full power at 95% efficiency will require an input of 5,263 W (rated power divided by efficiency). Inverters that

are capable of producing power at different AC voltages may have different efficiencies associated with each voltage.

- *CEC weighted efficiency*: This efficiency is published by the California Energy Commission on its GoSolar website. In contrast to peak efficiency, this value is an average efficiency and is a better representation of the inverter's operating profile. Inverters that are capable of producing power at different AC voltages may have different efficiencies associated with each voltage.[5]
- *Maximum input current*: This is the maximum amount of direct current that the inverter will use. If a DC power source, such as a solar array, produces an amount of current that exceeds the maximum input current, that current will not be used by the inverter.
- *Maximum output current*: The maximum output current is the maximum continuous alternating current that the inverter will supply. This value is typically used to determine the minimum current rating of the over-current protection devices (e.g., breakers and fuses) and disconnects required for the output circuit. Inverters that are capable of producing power at different AC voltages will have different maximum outputs for each voltage.
- *Peak power tracking voltage*: This represents the DC voltage range in which the inverter's maximum point power tracker will operate. The system designer must configure the strings optimally so that during the majority of the year, the voltage of the strings will be within this range. This can be a difficult task since voltage will fluctuate with changes in temperature.
- *Start voltage*: This value is not listed on all inverter datasheets. The value indicates the minimum DC voltage that is required in order for the inverter to turn on and begin operation. This is especially important for solar applications, because the system designer must be sure that there is a sufficient number of solar modules wired in series in each string to produce this voltage. If this value is not provided by the manufacturer, system designers typically use the lower band of the peak power tracking voltage range as the inverter's minimum voltage.
- *IPxx rating*: The Ingress Protection rating or IP Code classifies and rates the level of protection provided against the ingress of solid foreign objects (first digit) or water (second digit), a higher digit means greater protection. In the US the *NEMA enclosure type* is used similarly to the international rating. Most inverters are rated for outdoors installation with IP45 (no dust protection) or IP65 (dust tight), or in the US, NEMA 3R (no windblown dust protection) or NEMA 4X (windblown dust, direct water splash and additional corrosion protection).

Ref : http://en.wikipedia.org/wiki/Solar_inverter