

Future Trends in Distributed Renewable Systems

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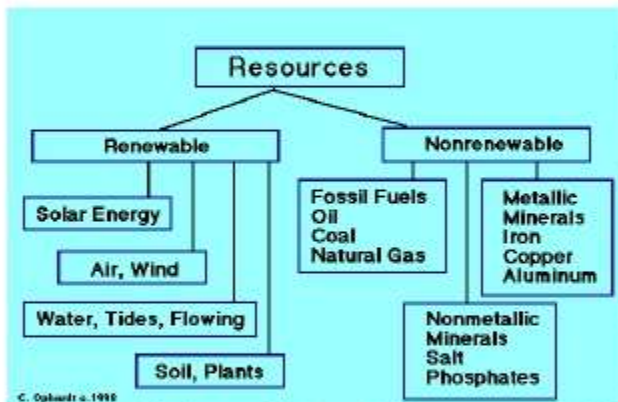
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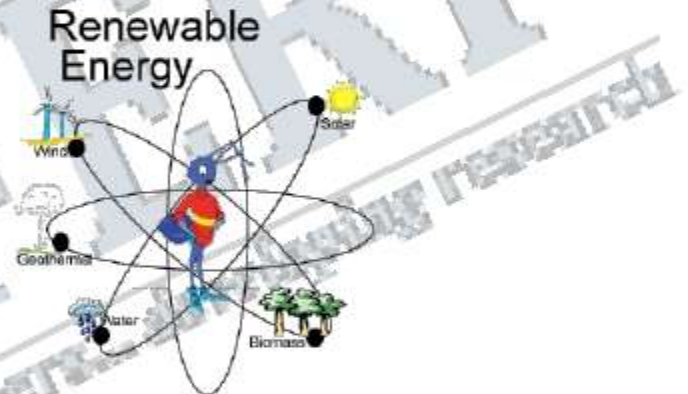
Abstract: This paper gives a review of Future Trends in Distributed Renewable Energy System. Distributed Renewable Systems (DER) or Distributed Generation (DG) systems are small-scale, on-site power sources located at or near customers' homes or businesses. Some common examples include rooftop solar panels, energy storage devices, fuel cells, micro turbines, small wind, and combined heat and power systems. Customers with these types of generation systems connect to the local electric grid and use the grid both to buy power from their local electric company during times when their DG Systems are not producing enough to meet their needs and to sell power to their electric Company when their systems are producing more electricity than is needed.

Index Terms— Distributed Renewable Energy System, Power Purchase Agreement, Feed-in tariff, Net metering

I. INTRODUCTION



More than 14% of the global population, still lack access to electricity. Distributed renewable energy technologies provide essential and productive energy services in remote and rural areas across the developing countries. In addition to the further spread of existing, well-established technologies (solar home systems, Pico-hydro stations, solar Thermal collectors, etc.), 2014 witnessed the evolution of new types of equipment, configurations, and applications. These include simple and inexpensive Pico-wind turbines for powering remote telecommunications; solar-powered irrigation kits; and digitization of ancillary services and monitoring, which allow for improved after-sales services and reduce costs so that companies can reach more people.



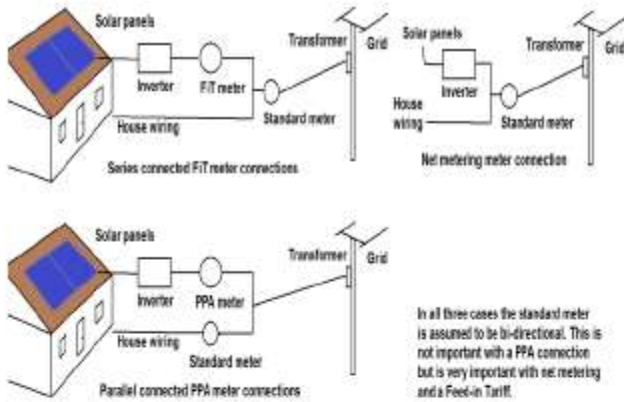
Distributed energy resource systems (DER) is modern electric power distribution system which refer to small grid connected decentralized energy generators that use renewable energy sources such as Biomass, solar and wind power. In sharp contrast to the conventional centralized coal-fire, hydro or nuclear power plants, DER systems are located close to the load and use modular, flexible technologies.

Around the world, there are three different tariff policies that are designed to foster private investment in distributed energy resource or Renewable system.

They are:

- Power Purchase Agreement
- Feed-in tariff
- Net metering

These three types are shown in a clear and systematic diagram shown below



Understanding Feed-in Tariff and Power Purchase Agreement meter connections

II. POWER PURCHASE AGREEMENT (PPA)

The power purchase agreement (PPA) is known as 'Standard Offer Program' which offers compensation generally below retail and above retail in case solar power generation. Renewable Power Purchase Agreement (PPA) allows agencies to fund DER projects with no up-front capital cost incurred.

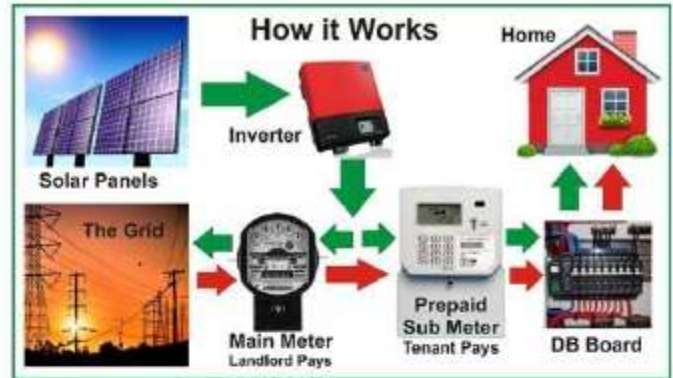
With the PPA, a developer installs a DER on agency property under an agreement that the agency will purchase the power generated by the system. The agency pays for the system through these power payments for the life of the contract, while the developer installs, own, operates and maintains the DER system over the same contract life.

Net purchase and sale is a different method of providing power to the electricity grid that does not offer the price symmetry of net metering, making this system a lot less profitable for home users of small renewable electricity systems.

Under this arrangement, two uni-directional meters are installed—one records electricity drawn from the grid and the other records excess electricity generated and fed back into the grid. The user pays retail rate for the electricity they use and the power provider purchases their excess generation at its avoided cost (wholesale rate). There may be a significant difference between the retail rate the user pays and the power provider's avoided cost.

The power purchase agreement (PPA) based system offers following benefits to the utility:

- 1) No capital cost
- 2) Long term energy plan
- 3) No operation and maintenance responsibility
- 4) Minimal risk



III. FEED-IN TARIFF (Fit)

FITs typically offer a guaranteed purchase agreement for long (15–25 year) periods. It achieves this by offering long-term contracts to renewable energy producers based on the cost of generation of each technology. Rather than pay an equal amount for energy, however generated, technologies such as wind power, for instance, are awarded a lower per-kWh price, while technologies such as solar and tidal power are offered a higher price, reflecting costs that are higher at the moment.

In addition, feed-in tariffs often include "tariff digression", a mechanism according to which the price (or tariff) ratchets down over time. This is done in order to track and encourage technological cost reductions. The goal of feed-in tariffs is to offer cost-based compensation to renewable energy producers, providing price certainty and long-term contracts that help finance renewable energy investments.

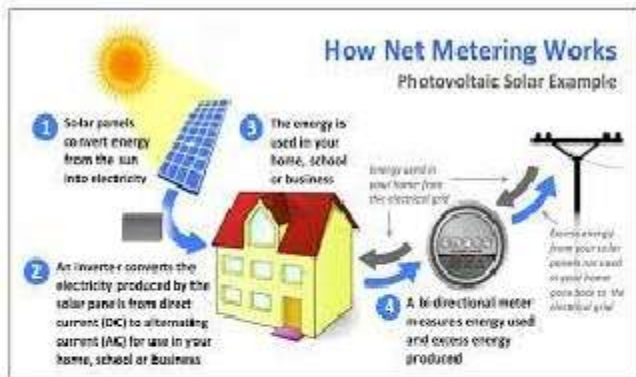
FITs typically include three key provisions

- 1) Guaranteed grid access
- 2) Long-term contracts
- 3) Cost-based purchase prices

Under a feed-in tariff, eligible renewable electricity generators, including homeowners, business owners, farmers and private investors, are paid a cost-based price for the renewable electricity they supply to the grid. This enables diverse technologies (wind, solar, biogas, etc.) to be developed and provides investors a reasonable return.

A feed-in tariff (FIT, standard offer contract) advanced renewable tariff or renewable energy payments is a policy mechanism designed to accelerate investment in renewable energy technologies.

IV. NET METERING (NM)



Net metering is about respecting and protecting the right of individual home owners to generate their own power for their own use particularly from a renewable resource. Net metering is a billing system that allows electric customers to sell to their electric company any excess electricity generated by their DG systems. While many different DG sources may be eligible for net metering credits, solar rooftop installations are by far the most common type of DG promoted with net metering.

Net metering policies were introduced to encourage the growth of DG systems when they first came to market years ago. While net metering policies vary by state, customers with rooftop solar or other DG systems usually are credited at the full retail electricity rate for any electricity they sell to electric companies via the grid. The full retail electricity rate includes not only the cost of the power but also all of the fixed costs of the poles, wires, meters, advanced technologies, and other infrastructure that make the electric grid safe, reliable, and able to accommodate solar panels or other DG systems. Through the credit, net-metered customers effectively are avoiding paying these costs for the grid.

Customer's electric bill is based on the electric company's cost of providing electric service. This includes the cost of the fuels used to generate electricity and the cost to transport and deliver the electricity to the customer. Costs also include the maintenance of the grid, as well as utility programs for low-income assistance, energy efficiency, environmental improvements, and other public benefits.

In general, every electric customer has an electric meter that records the amount of power delivered by its electric company. As electricity is used, the meter spins forward, much like a car's odometer records miles traveled. In the case of an electric meter, the meter records energy use in kilowatt-hours (kWh). Net-metered customers generally are credited for the electricity they sell to the grid, with their electric meter running backwards to provide a credit against the electricity that these customers must buy from their electric company at night or during other periods when their electricity use exceeds their system's output. Customers are only billed for their "net" energy use. That means that when

rooftop solar or other DG customers generate electricity, they avoid paying for the utility's power, which is fair because they did not use it. But, they also avoid paying for all of the fixed costs of the grid that delivers power when they need it and takes the power they sell back to the utility. As a result, these grid costs are shifted to those customers without rooftop solar or other DG systems through higher utility bills.

Advantages and Disadvantages

Feed-in Tariff

- Guaranteed contract to sell Electricity usually for a long period of 20 to 40 years.
- Allows you to sell all your power if you are able to generate more than your use.
- Feed-in Tariff requires two power meters.
- A separate generator account and a license are required.
- Guaranteed terms and low barriers to entry lead to job creation, economic growth.
- More complex to implement because you need to get a contract and it may be a competitive process.
- Fixed prices stabilize electricity rates, attract new investment.
- Usually rates paid by owners for electricity are higher than FIT contract prices therefore you may end up selling your electricity at one price and buying back the electricity you use at a higher price.
- No hedge against rapidly rising Electricity prices.

Net Metering

- Contract is short as compared to Feed-in Tariff.
- Can offset your bill and pay for electricity used in excess of what you generate.
- Net metering only requires one power meter.
- No license or contract is needed, easy and simple to implement.
- This allows you to easily bank excess electricity from your solar panels for future credit.
- Where exists, there are laws that guarantee your right to net meter and offset your bill.
- If you produce more than your use, you generally do not get paid for these KWH's, they expire.
- Act like a period hedge against rising Electricity prices.

V. CONCLUSION

Our country India is a nation of extremes, where poverty remains in areas with no energy services, while wealth grows in the new business hubs. But India is blessed with vast resources of renewable energy in solar, wind, biomass and small hydro.

Considered as “Emerging Economy” increasing GDP is driving the demand for additional electrical energy as well as transportation fuels. Currently there is absolute lack of public domain knowledge of technical standards and guidelines for grid connectivity, metering safety and security. Renewable projects so far, implemented in India have been either under gross metering arrangement or on captive consumption arrangements.

In this scenario, we hope that the information provided here for implementing a Fit mechanism for the residential consumers would prove useful for widespread proliferation of DER's in general and solar system in particular.

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