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Net Metering

Devaraja[1], Farheen Sultana[2], Firdous Jahan[3], Shabana Banu.S[4], Ravikumar H.M[5]
[1, 2, 3, 4]*Under Graduate Scholar,* [5] *Assistant Professor Department of Electrical and Electronics Engineering, Rao Bahadur Y Mahabaleswarappa Engineering College, India*

Abstract: ***Net metering is generally a consumer based incentive for renewable source such as solar power system also referred to as cogeneration. Most of the solar photovoltaic installation are connected to distribution networks. Net metering is a service available for electric customers who also own a generating unit. By using net metering service the energy produced which is not instantaneously consumed can be delivered to the local distribution network.Net metering mechanism provides usages of a bidirectional meter which has facility to record both import and export energy values. In net metering, prime focus is on utilizing self produced electricity by renewable energy sources and excess surplus is sold to utilities or grid.***

I. INTRODUCTION

Net metering (also known as net energy metering or NEM) is a billing arrangement that allows business and individuals generating their own electricity to deliver unused energy back to their local power grid and get credited back for its retail price. Utility customers are typically issued a meter to measure the amount of electricity being delivered from the grid. Organizations set up for solar net metering use specialized bidirectional meters that also track the amount of electricity flowing back to their local power grid. So when your literally burning the midnight oil, the bidirectional meter records how much electricity is being delivered to your facility.

And on the sunny side if your solar panel system is in full swing and producing more energy than your operation an use, the meter records how much electricity is received by the utility. A third reading on the meter displays the difference between the amount delivered and received, or “net“ energy used. It results into reduction of electricity bills. Solar photovoltaic system is used significantly in net metering. Commercial consumers are targeting purposefully. The study also on analyses the annual savings of electricity and economic feasibility in solar rooftop photovoltaic system. The study shows that lower payback period is achieved with solar rooftop photovoltaic system.

II. PROBLEM STATEMENT

Net Metering policies are effective at supporting solar power adoption but can threaten the financial stability of electricity distribution companies and result in cross-subsidies between electricity users once solar penetration grows. The solution is to align network charges with the real drivers of network costs.

III. LITERATURE REVIEW

A. This project is about application oriented power generation through renewable energy sources. Till today’s date this project was not implemented in residential area of India. Thus it should have to perform on our own responsibility. Referencing the information on Internet, we precede the work step by step. Power Generation through solar panels .we design circuit for net metering which is useful & efficient for use net metering for residual area. To design inverter, we refer various related to design of inverter and its individual component. The component to be decided according to requirement we brought on ratings for filters, converters.

B. In the present policy of net metering, a single meter with a solar generating capacity is acceptable with a fixed limit on size of solar panels based on annual consumption units. For consumers with lesser requirement of energy, the individual net metering option is not financially viable. There are cases where a consumer owns multiple meters or meters at different sites, which is not accounted in simple net metering policy.

C. The advent of smart grid has led to a dire need of change in energy policies for realization of benefits of smart grid to its full potential [1]. Smart meters would augment the net metering policy and play a big role in making net metering successful in India. In this paper, a new model is proposed for net metering through analysis and simulation of data collected from three different types of consumers. The paper aims to propose a modification for net metering policy in India taking in account, the needs and requirements of majority of population, so that the green energy is in reach of the masses.

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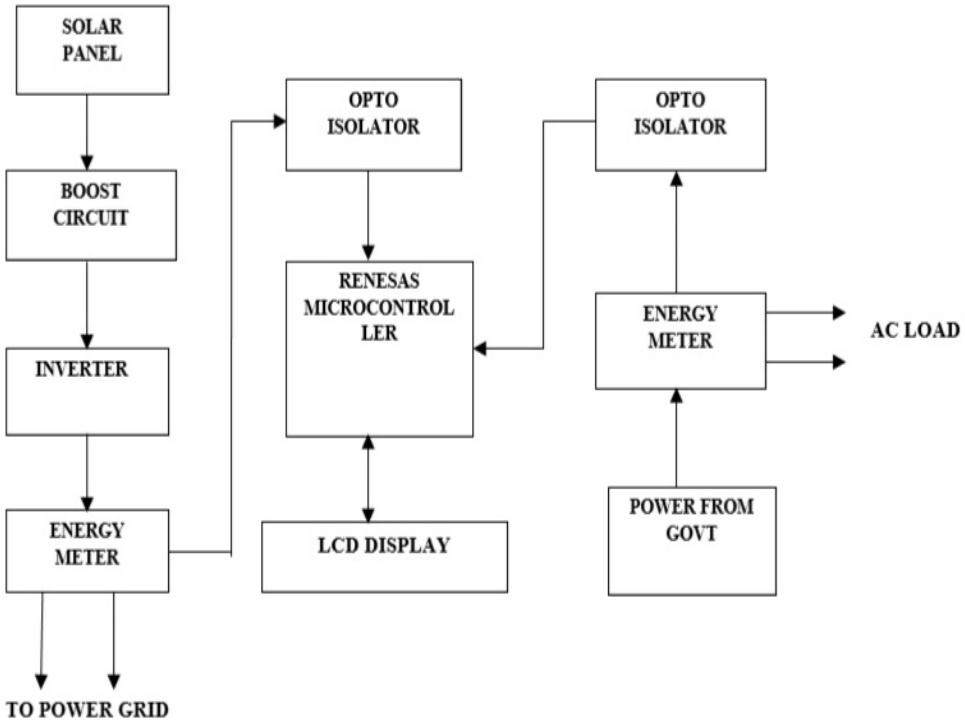
IV. METHODOLOGY

The basic setup of the complete project consists of Solar panel, Inverter, 8051 microcontroller, Opto Isolator, Energy meters, LCD, Load. The proposed system demonstrates the individuals to generate their own electricity and to deliver unused energy back to their local power grid and get credited back for its retail price.

V. WORKING

The photovoltaic Solar panels absorb sunlight as a source of energy to generate electricity. As the voltage produced by the solar panels is not sufficient hence boost converter is used. Boost converter is a DC to DC power that steps up the voltage of solar panels. The power produced by the solar panels is DC and therefore inverter should be connected to convert power into AC. Then the energy meter measures the amount of electric energy consumed by the residence and the excess power is sold to the grid. During off load conditions the power produced may not be sufficient thereby certain amount of power is borrowed from the Government. Similarly another Energy meter measures the amount of electric energy received from the government. The energy consumed by the residence and borrowed from the government is monitored by the microcontroller and the difference is calculated. The difference is then displayed on the LCD and is calculated in units. Therefore net metering is process that allows business and individuals generating their own electricity to deliver unused energy back to their local power grid and credited back for its retail price.

VI. BLOCK DIAGRAM



A. Components

1) Solar Panels
2) Grid-Tie Inverter
3) 8051 microcontroller
4) Energy Meters
5) Boost Converter
6) Opto Isolator
7) LCD

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VII. COMPONENTS DESCRIPTION

A. Solar Panels

The photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. A standard solar panel (also known as a solar module) consists of a layer of silicon cells, a metal frame, a glass casing and various wiring to allow current to flow from the silicon cells. Silicon (atomic 14 on the periodic table) is a nonmetal with conductive properties that allow it to absorb and convert sunlight into electricity. When light interacts with a silicon cell, it causes electrons to be set into motion, which initiates a flow of electric current. This is known as the "photovoltaic effect," and it describes the general functionality of solar panel technology.

The general photovoltaic process, as described above, works through the following steps:

1) The silicon photovoltaic solar cell absorbs solar radiation.
2) When the sun's rays interact with the silicon cell, electrons begin to move.
3) Moving electrons creates a flow of electric current, captured by nodes and wiring in the panel.
4) Wires feed this direct current (DC) electricity to a solar inverter to be converted to alternating current (AC) electricity.

B. Grid-Tie Inverter

Grid-tie inverters convert DC electrical power into AC power suitable for injecting into the electric utility company grid. The grid tie inverter (GTI) must match the phase of the grid and maintain the output voltage slightly higher than the grid voltage at any instant. A high-quality modern grid-tie inverter 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 that senses the current AC grid waveform, and outputs 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 with solar panels. 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 shuts down to prevent the energy it transfers from harming any line workers who are sent to fix the power grid.

C. Renesas Microcontroller

Renesas Electronics RL78 16-bit Microcontrollers deliver ultra lower pow consumption, enhanced performance, high integration, and an extensive range of powerful peripheral functions. These features make the RL78 MCUs ideal for a number of applications, including battery-operated devices and household applications. The Renesas RL78 Microcontroller MCU Series consists of both general-purpose and application-specific devices. These MCUs make possible ultra-low-power applications by giving system designers advanced power-saving features and high-performance operation. Devices provide 1KB to 512KB of on-chip flash memory and are offered in over 30 package options, from 10 to 128 pins. These low-power MCUs are excellent solutions for a wide range of low-power and battery-operated products and systems used in global consumer, industrial, and automotive markets.

D. Energy Meters

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises for billing purposes.

They are typically calibrated in billing units, the most common one being the kilowatt hour (*kWh*). They are usually read once each billing period. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a day, to record usage during peak high-cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods.

Electricity meters operate by continuously measuring the instantaneous voltage (volts) and current (amperes) to give energy used (in joules, kilowatt-hours etc). Meters for smaller services (such as small residential customers) can be connected directly in-line between source and customer.

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E. Boost Converter

A boost converter (step-up converter) is a DC to DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched mode_power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors are normally added to such a converter's output and input. Power for the boost converter can come from any suitable DC sources, such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC to DC converter with an output voltage greater than the source voltage.

F. Opto Isolator

An optoisolator consists of a light-emitting diode (LED), IRED (infrared-emitting diode) or laser diode for signal transmission and a photosensor (or phototransistor) for signal reception. Using an optoisolator, when an electrical current is applied to the LED, infrared light is produced and passes through the material inside the optoisolator. The beam travels across a transparent gap and is picked up by the receiver, which converts the modulated light or IR back into an electrical signal. In the absence of light, the input and output circuits are electrically isolated from each other. The optoisolator is enclosed in a single device, and has the appearance of an integrated circuit (IC) or a transistor with extra leads. Optoisolators can be used to isolate low-power circuits from higher power circuits and to remove electrical noise from signals.

G. LCD

A liquid crystal display (LCD) is a flat panel display, electronic visual display, based on Liquid Crystal Technology. A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present information. Liquid crystals do not emit light directly instead they use light modulating techniques. LCDs are available to display arbitrary images fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement.

1) The size of LCDs comes in wider varieties.
2) They do not use Phosphor; hence images are not burnt-in.
3) Safer disposal
4) Energy Efficient
5) Low Power Consumption

VIII. ADVANTAGES

A. Eliminated or reduced utility bills.
B. Financing options for every budget.
C. Availability of incentives and rebates.
D. Easy installation.
E. Low maintenance.
F. Solar energy is unlimited and available everywhere.
G. It reduces transmission loss.
H. Reduction in electricity consumption from the grid.

IX. APPLICATIONS

A. The generated power can be used to supply the power to the house loads like bulb, fan and tube light and other small equipment.
B. The generated power can be stored and can be supplied to station for the electrification of lamp around industry.
C. The generated power can be used to light many powerless homes.

X. DISADVANTAGE

A. Transmission of unwanted direct current into the grid.

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XI. CONCLUSION

Net Metering is one of the best way to recover waste energy by generating power which is primary need of metro cities. Simply, its a process in which the electricity board keeps the track of energy consumed as well as generated by a solar powered house. It allows consumers to feed surplus solar power into the states power grid when they don't need it, and receive a credit on their electricity bill.With net metering systems you only pay for the deficit power consumed that is the difference between the power consumed by the household from the grid and the solar power generated from the panels. This drastically reduces your electricity bill while giving you an opportunity to earn an income.

XII. FUTURE SCOPE

As the hunger for alternative forms of energy continues, these type odd projects are generating hope.Indian government has decided to equip all the government offices, hospital, collage, with roof top PV system & Involve them in Net Metering.

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About Authors



Mr. Ravikumar H M
B.E.(Electrical and Electronics),Rao Bahadur Y Mahabaleswarappa Engineering College,Bellary,visvesvaraya technological University, Belagavi
M.Tech (Power Electronics), Jawaharlal Nehru national College of Engineering (Shivamogga)
Email-ravikumarhm777@gmail.com



Mr. DEVARAJA
B.E(Electrical And Electronics),Rao Bahadur Y Mahabaleswarappa Engineering College(VTU),Bellary
Email-devarajadevu822@gmail.com



Ms. FARHEEN SULTANA
B.E(Electrical And Electronics),Rao Bahadur Y Mahabaleswarappa Engineering College(VTU),Bellary
Email-farheeneee24.rymec@gmail.com

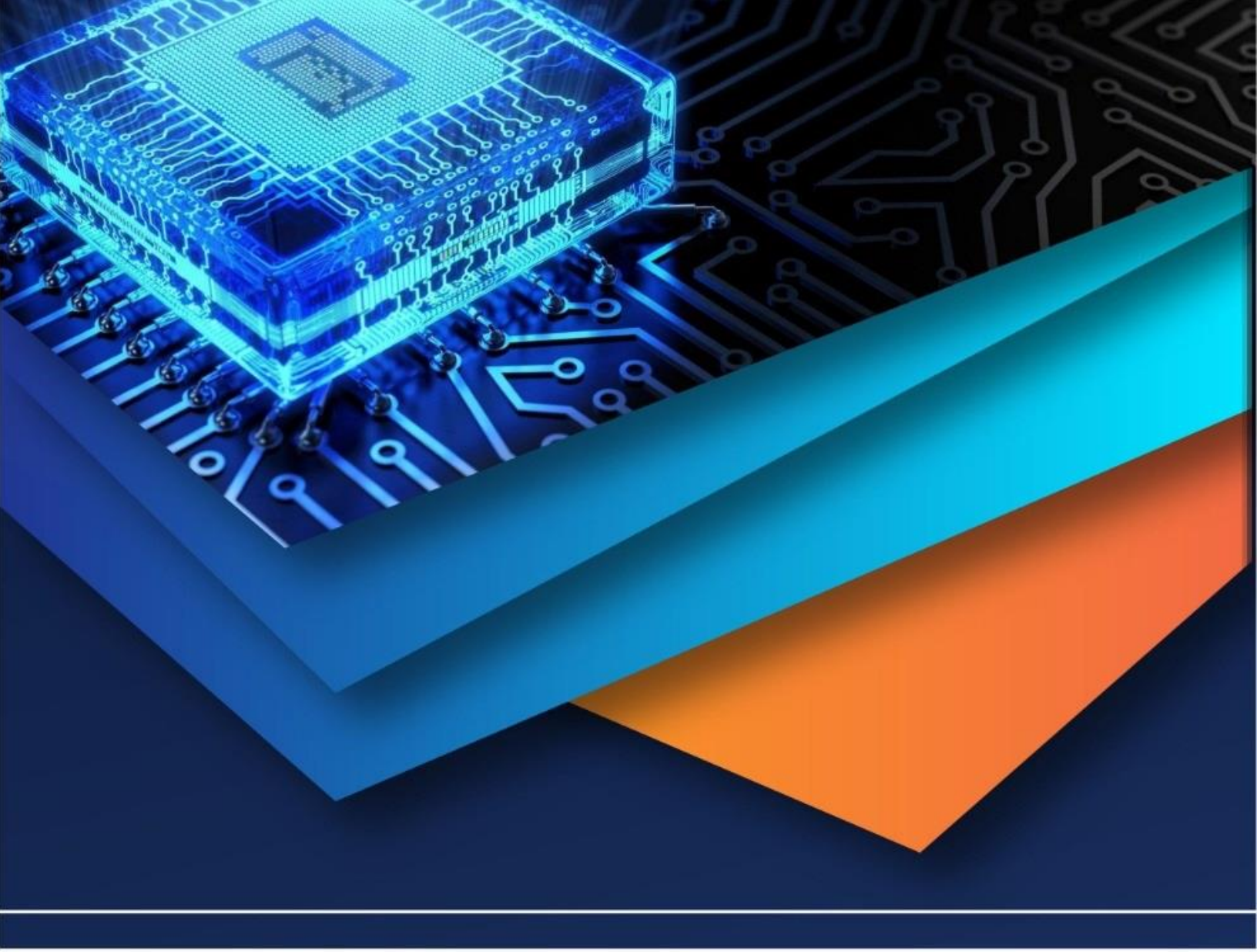


Ms. FIRDOUS JAHAN
B.E(Electrical And Electronics),Rao Bahadur Y Mahabaleswarappa Engineering College(VTU),Bellary
Email-firdousjaan97@gmail.com



Ms. SHABANA BANU.S
B.E(Electrical And Electronics),Rao Bahadur Y Mahabaleswarappa Engineering College(VTU),BELLARY
Email-shabanashabz80@gmail.com

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