# Design and Implementation of Solar – Wind Combo for Hybrid Energy Application

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**ABSTRACT—**Nowadays, world demands energy conservation due to the replenishment of the non-renewable energies such as coal, petroleum and natural gas. In developing countries like India,  power consumption plays  a vital role since the replenishment of the coal in the power plant. This project provides an innovative solution to the power demand by using renewable energy such as wind and solar. In this project both the wind and solar are combined together to get the desired amount of energy. This configuration allows the two sources to supply the load separately or simultaneously depending on the power demand. Because of the inherent nature of this Cuk-SEPIC fused converter, additional input filters are not necessary to filter out high frequency h a r m o n i c s. Simulation results are used to highlight the merits of the proposed circuits.

**INDEX TERMS—** Solar, Wind,  Cuk-SEPIC, Hybrid

## I. INTRODUCTION

With   increasing   concern   in   renewable energy  systems with  various  sources  becomes  greater than before.  Renewable energy  sources  such as photovoltaic (PV)  and  wind  energy  can  be  used  to  enhance  the safety, reliability, and sustainability of a power  system.  Renewable energy  resources will  be  increasingly an important part of power  generation in  the  new  millennium .   There  is  an enormous  need   for  integrated  power converters that  are capable  of  interfacing  and  controlling several  power terminals  with  low  cost  and compact    structure.     The utilization  of  natural  energy  is recognized  as a new  energy source   which   will eventually replace  conventional energy sources.   Renewable energy  sources  do  not  have  the  high external cost and  social  issues. Renewable energy  sources such as wind,  solar,  fuel  cell  holds  more  potential  to  meet our energy   demands.  This  proposal  focuses   on  control   of two major  renewable-energy sources:  PV and  wind energy.

## II.       HYBRID ENERGY

Hybrid  Renewable Energy  systems (HRES) are  becoming popular for remote  area power  generation applications due  to  advances  in  renewable  energy technologies and subsequent rise in prices  of petroleum products.  A hybrid energy  system  usually  consists of two  or more renewable energy  sources  used together to provide increased system efficiency  as  well  as  greater  balance in energy  supply.

## III.       WIND ENERGY

Wind   energy  is  the  fastest-growing renewable source  of  clean  energy.  It has  shown  its  great  potential for combating  climatic  change,   ensuring  clean   and   efficient energy.   It  can  make  major  contribution towards satisfying  the  global   need   for  clean  and  RES .  For  modeling  the energy   produced  by  wind   power,   all components  in  the system  is  to  be  modeled.   First  the  wind  turbine  has  to  be modeled,   including   the mechanical  drive  train,  such  as shafts,   gearboxes   and   bearings.   Second  the  electrical machine,  mostly  a synchronous  machine  is  modeled in detail  and  connected  to  a  model  of  the  power  electronics, such as controlled rectifiers or back to back converters.

### IV.        SOLAR ENERGY

Photovoltaic (PV) offers an environmentally friendly source of electricity. Worldwide, photovoltaics account for 500 MW of power generation with an annual growth rate greater than 20% . In the near future photovoltaic power is expected to become more cost effective and will be almost price competitive with traditional sources of energy. With development and breakthrough in new cell materials and power electronics technologies solar power can prove to be an efficient, environmental friendly and safe means of power. In this module the solar cells is a fundamental power conversion unit of a photovoltaic system.Due to the fact that solar and wind energy source is intermittent and quite variable, longitude, latitude, weather and limited daytime should be considered in acquiring electrical energy from PV system and wind turbine system and also it is possible that power fluctuations can be observed since photovoltaic and wind power source is highly dependent on the weather conditions.In the near future using hybrid systems for electricity generation may have more profitable in parallel with the technological advances. Photovoltaic and wind systems are the source of energy in standalone systems.. The easy installation and maintenance free operational feature of the hybrid system created more popularity among the rural masses.
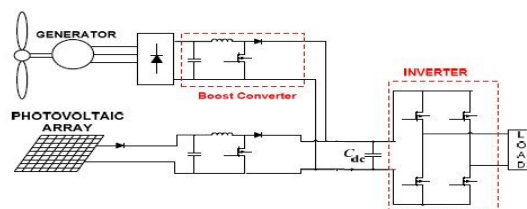
Hybrid Energy Model



Fig. 1

Wind and solar power are given as input to the converter. Wind model and solar model are separately modeled. In this proposed model, a hybrid system with multi input integrated converter structure is proposed. The circuit consists of integrated cUk-sepic converters. The inherent nature of the proposed converter is that, it does not require additional input filters to filter out the frequency harmonics. The output from converteris given to inverter which converts dc to ac and is applied to load. The load used hereisresistive load. By using these converters, step up and step down operations can be done. The proposed converter is valuable for renewable energy harvesting applications.

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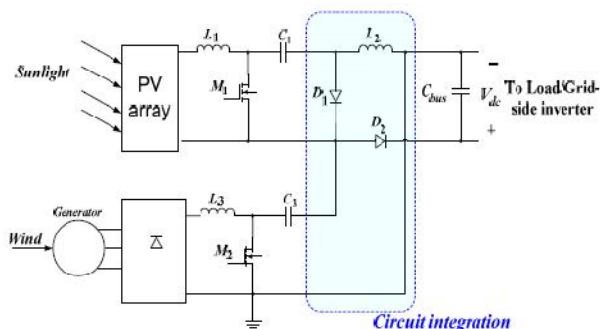
I. Multi- Input Rectifier Stage



Fig.2

A system diagram of the proposed rectifier stage of a hybrid energy system is shown in Figure 2, where one of the inputs is connected to the output of the PV array and the other input connected to the output of a generator. The fusion of the two converters is achieved by reconfiguring the two existing diodes from each converter and the shared utilization of the Cuk output inductor by the SEPIC converter. This configuration allows each converter to operate normally individually in the event that one source is unavailable. Figure 3 illustrates the case when only the wind source is available. In this case, $D_1$ turns off and $D_2$ turns on; the proposed circuit becomes a SEPIC converter and the input to output voltage relationship is given by (1). On the other hand, if only the PV source is available, then $D_2$ turns off and $D_1$ will always be on and the circuit becomes a Cuk converter as shown in Figure 4.
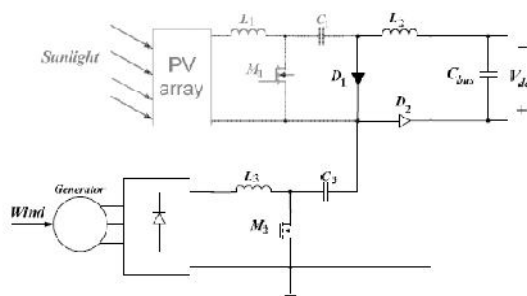

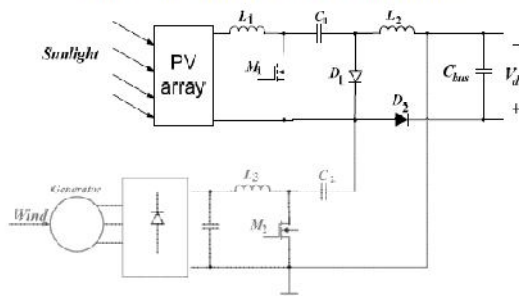
Figure 3: Only wind source is operational (SEPIC)



Figure 4: Only PV source is operation (Cuk)

Figure 5 illustrates the various switching states of the proposed converter. If the turn on duration of $M_1$ is longer than $M_2$, then the switching states will be state I, II, IV. Similarly, the switching states will be state I, III, IV if the switch conduction periods are vice versa. To provide a better explanation, the inductor current waveforms of each switching state are given as follows assuming that $d_2 > d_1$; hence only states I, III, IV are discussed in this example. In the following, $I_{i,PV}$ is the average input current from the PV source; $I_{i,W}$ is the RMS input current after the rectifier (wind case); and $I_{dc}$ is the average system output current. The key waveforms that illustrate the switching states in this example are shown in Figure 6. The mathematical expression that relates the total output voltage and the two input
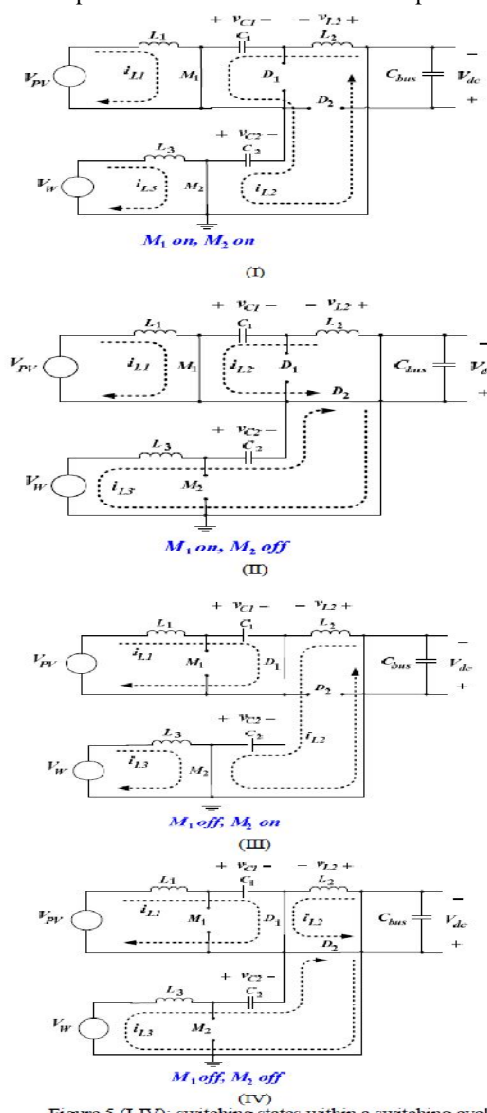


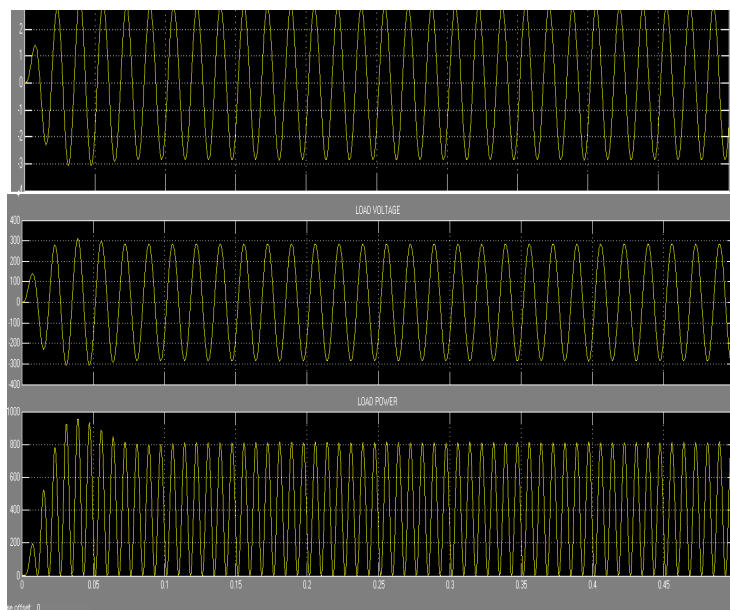Figure 5 (I-IV): switching states within a switching cycle

sources will be illustrated in the next section.

SIMULATION OUTPUT CURRENT, VOLTAGE AND POWER

## V.    CONCLUSION & FUTURE WORK

The hybrid wind and solar power generation can be used to generate large amount of power at almost all times of a day. This can be an alternative source of energy to the non-renewable resources. This can be implemented instead of a single source , to gain more power almost at all times.  The generation of hybrid wind and solar power has been simulated using Mat lab software and output waveform for voltage, current and power have been obtained which provide the comprehensive and constructive knowledge about the same system in hardware. The hybrid wind and solar system will be implemented in hardware with specified components.

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## REFERENCES

**1.** A Hybrid Wind-Solar Energy System: A New Rectifier Stage Topology JoanneHui*,*IEEE Student Member*, AlirezaBakhshai ,*IEEE Senior Member*, and Praveen K.Jain, *IEEE Fellow*  Department of Electrical and Computer Engineering Queen's Center for Energy and Power Electronics Research (E POWER),Queen'sUniversityKingon,Ontario,Canada .
**2.**Standalone Hybrid Wind Solar Power Generation System Applying Dump Power Control Without DumpLoad To shiro Hiroseand Hirofumi Matsuo, *Fellow,IEEE*
**3.**Optimization of Solar-Wind HybridSystem for Distributed Generation Parita Dalwadi,V.Shrinet,CRMehta, andPankitShah
**4.** MODELING ANDSIMULATIONOFRENEWABLE HYBRID POWERSYSTEMUSING MATLAB/SIMULINK ENVIRONMENTCristian DragoşDumitru, AdrianGligor"PetruMaior"UniversityofTârguMureş,Romania.
**5.** SIMULATION WITH THE SEPIC TOPOLOGY (SEPIC-Single Ended Primary Inductance Converter) ECE562: Power I COLORADO STATE UNIVERSITY Modified in Fall 2011
**6.** Selection, Design and Construction of Offshore Wind Turbine Foundations SanjeevMalhotra,PE,GE ParsonsBrinckerhoff,Inc. United States of America