Hybrid renewable energy systems that are designed to match load requirements can allow for a more broad expansion of the economic integration of renewable energy across the country. This study outlines the design of a solar-wind hybrid renewable energy system for a grid-tied home with a time dependent electric rate structure based on previous independent solar PV and wind turbine studies. This approach then leads to a design philosophy for hybrid renewable energy systems.

Resources

Every location on earth has its own unique set of natural resources to draw upon for sustainable energy production, as shown for the cases of solar and wind resources in Figures 1 and 2 below. As these resources are generally of an intermittent nature (as shown in Figures 3 and 4), hybrid renewable energy systems will be necessary in many situations to achieve economical energy independence while meeting our inconsistent demand for electricity with minimal or no energy storage. Wind and solar resources often have complimentary attributes that combined can more closely match energy need requirements. This match can be customized for optimum economy by adjusting the orientation and design of the PV system as well as the rotor length and generator size of the wind turbine system.

Resource Intermittency

Incident solar radiation varies not only by latitude and diurnal patterns, but also by instantaneous changes in cloud cover and air quality. Figure 3 shows the difference between incident radiation on a clear day vs a cloudy day. Wind speeds also vary with location as well as in time due to various meteorological and geophysical mechanisms. Figure 4 shows a sample set of wind data and how this translates into power output using a typical 2 MW wind turbine power curve.

Conclusions and Developing Work

The economics of renewable energy systems can be enhanced by drawing upon multiple renewable energy resources as well as by considering the electric rate structure in the systems’ design. Work currently underway includes development of a design approach for hybrid renewable energy systems as depicted in Figure 5. In conjunction with this, TRNSYS software is being used to create transient hybrid renewable system models of real systems. The model will then be verified and integrated into the design approach to create an overall hybrid renewable energy system design tool. This tool could then be used to quickly and effectively integrate renewable energy technologies into any building or facility for a wide variety of users.

Analysis Tools

The economics of renewable energy systems can be enhanced by drawing upon multiple renewable energy resources as well as by considering the electric rate structure in the systems’ design. Work currently underway includes development of a design approach for hybrid renewable energy systems as depicted in Figure 5. In conjunction with this, TRNSYS software is being used to create transient hybrid renewable system models of real systems. The model will then be verified and integrated into the design approach to create an overall hybrid renewable energy system design tool. This tool could then be used to quickly and effectively integrate renewable energy technologies into any building or facility for a wide variety of users.

References: