Peru off-grid systems

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Renewable energy sources (RES) are abundant in most parts of the world, and, unlike fossil fuels, can be harnessed without any cost for the resource. In this regard, many governments have already started to finance renewable technologies by means of direct grants, loans and tax incentives (Liu et al. 2012). Electricity generation in Peru through hydro, wind, solar, geothermal, biomass, tidal power or other RES is subjected to an annual maximum 20% depreciation regime for income tax purposes (Irena 2014).

Utilizing the climatic information from NASA surface meteorology and solar energy (NASA 2017), the average monthly solar irradiations are determined for each location (Fig. 4a). Among selected communities, El potrero has the highest average yearly irradiation (3.145 kWh/m2) and Silicucho has the lowest one (2.326 kWh/m2). As can be noticed in Fig. 4a, during winter (months of May-July), solar irradiation reaches its lowest values, leading to small power production from the PV source.

Average monthly data for wind speed have been extracted from NASA surface meteorology and solar energy (NASA 2017). As displayed in Fig. 4b, Silicucho is the windiest region among all of selected communities with average wind speed of 7.16 m/s. Due to the fact that HOMER calculates the generated power based on the wind speed at the hub height, the altitude of each area should be given as input to the software. HOMER uses logarithmic law to assess the speed of wind at the hub height, as described in Eq. (1).

After high growth rates for several consecutive years and reaching around USD100/barrel in 2013 (Kojima 2016) oil price has experienced a sharp fall in the recent years and in 2017 it reached ca. USD 50/barrel. Following these changes, diesel price estimation for remote areas in Peru has decreased from 1.41 USD/L in 2013 (GIZ 2013) to 0.8 USD/L in 2017 (Global Petrol 2017).

The major components of hybrid systems are photovoltaic panels, wind turbines, diesel generators, batteries, and power converters. Table 2 summarizes the capital, replacement and maintenance costs of all component of the hybrid system used in HOMER.

Solar panel electricity generation systems, also known as solar photovoltaic, harness solar energy using photovoltaic cells and convert it into DC electricity energy in direct proportion to the solar irradiation incident upon it (Liu et al. 2012). The power output of a solar panel can be calculated using Eq. (2).

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Web: https://sumthingtasty.co.za/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346