Technical data of a grid-connected photovoltaic/wind hybrid system with and without storage battery for residential buildings located in a warm area

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Abstract

Electric production data of a grid-connected hybrid system are presented. The system consists of a photovoltaic generator, a wind micro-generator in the presence (HPWBS) or absence (HPWS) of an electric storage system. In such a system, the power generated by RES (renewable energy sources) is sent directly to balance the load. A residential use has been analysed in warm climate.

The analysis has been carried out by TRNSYS 17 (Transient System Simulation) software and the mathematical modelling and the energy balance of the system have been shown in Mazzeo et al. (2018).

The annual energy performance has been evaluated, in terms of dimensionless balance of the generated energy and dimensionless balance of the energy required by the load, for 375 hybrid system configurations. These configurations were obtained by varying the photovoltaic power, the wind power and the battery storage capacity, considering different hourly average daily values of the load.

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Specifications Table

| Subject area                        | Civil engineering and electric renewable power plants |
|------------------------------------|------------------------------------------------------|
| More specific subject area         | Electric energy self-production and storage systems powered by renewable sources |
| Type of data                       | Tables                                               |
| How data was acquired              | Experimental acquisition, technical data sheets, analysed and processed output data by the software TRNSYS. |
| Data format                        | Raw data outgoing from simulations                   |
| Experimental factors               | Weather data and TRNSYS setup                        |
| Experimental features              | The values are presented in terms of energy balances: renewable energy production, energy storage, energy produced in excess, energy drawn from the grid. Reliability energy indicators are reported. |
| Data source location               | The weather data were measured on the roof of a building of University of Calabria in Rende, a city in the province of Cosenza, Calabria - Italy |
| Data accessibility                 | Data is within this article.                         |
| Related research article           | D. Mazzeo, G. Oliveti, C. Baglivo, P. M. Congedo, Energy reliability-constrained method for the multi-objective optimization of a photovoltaic-wind hybrid system with battery storage, Energy, Volume 156, 2018, Pages 688–708, ISSN 0360–5442, https://doi.org/10.1016/j.energy.2018.04.062 |

Value of the data

- The data are useful to evaluate the energy behaviour of the HPWBS by varying the nominal powers of the main components;
- The data are useful for a comparison of hybrid systems with or without a storage system;
- The data are useful to identify the most energy reliable system configurations for a given load;
- The data are useful for a comparison with different climate conditions and uses to evaluate the energy reliability of the same HPWBS but stand-alone.

1. Data

The HPWBS is composed of the following elements, as shown in Fig. 1:

- wind system: wind micro-generators and AC/DC rectifier;
- photovoltaic system: photovoltaic modules and DC/DC converter;
- storage battery;
- regulator;
- DC/AC inverter.

The parametric analysis was performed by varying the load scenarios and the characteristics of the three main components. The variable parameters are related to the nominal power of photovoltaic system and wind system, the storage capacity of the battery and the load.

The hourly average daily electric load values are equal to 0.5 – 1.0 – 2.5 – 5.0 – 10.0 kW.

For the battery, the values of storage capacity are considered equal to 0 – 2 – 4 – 6 – 8 - 10 kWh, obtained by changing the numbers of storage battery.

About the photovoltaic generator, the values of nominal power are equal to 2.5 – 5 - 10 kW; the number of modules in series is the parameter that permits to vary the nominal power.
As regards wind generator, the values of nominal power are considered equal to 2.5 – 5 – 7.5 – 10 -15 kW. Several micro-generators with nominal power of 2.5 kW were installed.

The Supplementary materials HPWBS_data.xls provides the values of the renewable energy production, energy storage, energy produced in excess, energy drawn from the grid, and reliability energy indicators for each combination, grouped for each load in different excel sheets.

2. Experimental design, materials and methods

The calculation has been performed for a residential university building located in a warm area, in accordance with the following phases:

1. mathematical modelling of the hybrid system;
2. hourly dynamic simulation to obtain the annual powers in input and in output from the system;
3. dimensionless representation of the results;
4. definition and calculation of proper indicators to represent the system energy reliability;
5. evaluation of the system energy reliability by parametric analysis by changing the components size;

multi-objective optimization analysis development by means of ERC method.

The dynamic simulations have been carried out using TRNSYS 17 (TRaNsient SYstem Simulation) tool. As shown in [1] in detail, the specific Types used for the calculations are:

- Type 9 which permits the importation of the experimental climate data;
- Type 16 reports on the inclined plane the incident solar radiation on the horizontal plane;
- Type 94 for the photovoltaic generator;
- Type 90 for the wind generator;
- Equation blocks for the static converters;
- Type 48 for the storage battery;
- Type 47 for the regulator and the inverter;
- Type 14 for the load trend;
- Type 25 allows printing results.
Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.08.083.

Appendix A. Supporting information

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Reference

[1] D. Mazzeo, G. Oliveti, C. Baglivo, P.M. Congedo, Energy reliability-constrained method for the multi-objective optimization of a photovoltaic-wind hybrid system with battery storage (ISSN 0360–5442), Energy 156 (2018) 688–708. http://dx.doi.org/10.1016/j.energy.2018.04.062.